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## On the Occasion of Publication of *the Journal of Socio-Informatics*

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It has been quite a while since the words "information society" appeared in our world and the Internet permeated all the corners of our everyday life.

The "information" not only improves social efficiency and convenience, but also affects social basic structure and is transfiguring the action of the world and its people greatly.

While various possibilities and expectations lurk there, problems which should be solved and countless barriers which must be overcome are also produced. And the evolution of "information" engenders a new learning domain not only transcending time and space, but becoming world-wide. Therefore we demand a new study, Socio-Informatics which treats information interdisciplinarily and synthetically. That discipline has been studied for ten years or more by two societies called JASI (Japan Association for Social Informatics) and JSIS (Japan Society for Socio-Information Studies). There, progress is being made on resolving questions like "What is information?", "What kind of change is information technology causing to human relations or social structure?" and "What is the design for a desirable society which is taken and constructed to elucidate a concrete everyday social phenomenon or a social problem?"

Our journal sends the results of such issues

to the world at large, and is just published in order to carry out investigation of the many problems of "light and shadow" which "information" causes between people in the world.

The candidates for research of Socio-Informatics are very broad-ranging; for example, the following themes are contained.

- \* Basic theory of Socio-Informatics
- \* Information, economy, and city
- \* Law and security of information society
- \* Media and culture
- \* Communication and social relations
- \* Information and communication technology and regional vitalization
- \* Social applications of information systems
- \* Methodology of Socio-Informatics: social research method, game theory, simulation, network analysis, etc.
- \* Information education seen from viewpoint of Socio-Informatics

Of course, in addition, various target areas can be considered.

The objectives of Socio-Informatics are:

1. To solve various aspects of production, circulation, accumulation, and use or consumption of information in society.
2. To reconstruct a theoretical framework about a social system from the viewpoint of

"Information."

3. To search for a relationship between the new information/communication network and social system.

This is a new area of study.

Thus, Socio-Informatics is a dynamic movement which creates new intelligence.

There are three engines (shown in Figure 1) in this movement. They embody these three approaches: basic theory that positions the target problem systematically; the actual proof and analysis that objectively describes the target phenomenon and practice; and practical problem solving for the resolution.

And they are driving the whole system we call Socio-Informatics, interdependently, these three approaches serving as mutual engines.

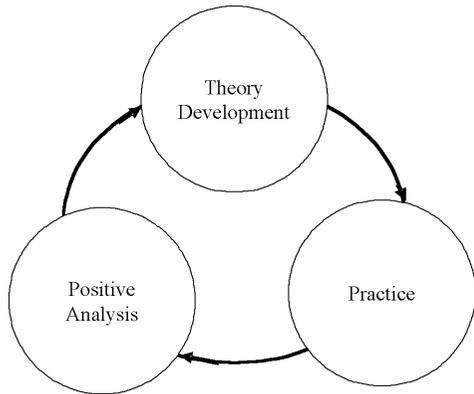


Figure. 1 Three engines of Socio-Informatics

Who plays the main role in Socio-Informatics? Of course, "the researcher of Socio-Informatics" does. However, the term "researcher" does not only apply to people who belong to a university or a research institution. All those who just regard "Socio-Informatics" as "a problem which is here now", and try to tackle problem-solving with a research mentality are "researchers." Socio-Informatics is open to companies, self-governing bodies, and anyone who finds problems in daily life (Figure 2).

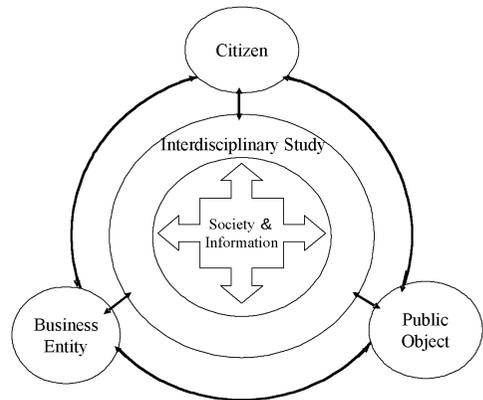


Figure. 2 Bearers of social information study

Taking advantage of this open nature, it is also the task of social information study to reorganize the collection of various "intelligence" in society and design a rich future. We would like to ask you for your positive participation and support to our journal as an information hub open to the world.

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# An Infosocionomist's View

Shumpei KUMON, Tama University

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Good Morning. The resume you have has been revised a bit but it's almost the same, so please take a look at it.

I know this academy is called the Socioinformatics Forum, but I have founded Infosocionomics Society. I feel sorry for the confusing name.

It is difficult to directly reply to questions regarding "Inquiring now the Socioinformatics," so today I'd like to talk about what problem consciousness Infosocionomics has and I'd be happy if you make it a reference or get some stimulation from it.

As you can see on the slide, I worked for many years at the Faculty of Arts of Tokyo University with Yasusuke Murakami and Seizaburo Sato, and the lifework for Murakami was, so to speak, "Industrial Society-ology", which I think was the general and interdisciplinary study of Industrial Society. From this viewpoint he published works such as "Pathology of The Industrial Society," "The Era of the New Middle Mass" or "Anti-classical Political Economy," but after Murakami's death I wondered in many ways what I should do to succeed his lifework of "Industrial

Society-ology," and I realized that the following issues still remain.

Many 20th century economists besides Murakami identified modern society with industrial society, while political scientists regard the rise of nation states or sovereign states as the beginning of modernization. From economists' point of view, however, the full-scale foundation of the nation state was achieved only after industrialization. Thus they emphasize that it was industrialization that provided the foundation for the modern, full-fledged nation state. However, if you are free from the notion that "Industrial Society = Modern Society," you may be able to have a different view.

By the way, one well-known idea about the social revolution that includes modernization as a part of it is Alvin Toffler's "Third Wave" theory that adopted a trichotomy of human history into the pre-modern, modern and post modern eras. Toffler asserts that since the 1980s the "3rd wave society" emerged, following the agricultural and industrial societies. However, terms such as "information revolution" or "information society" were not

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This Paper is the keynote lecture of the joint conference of the JSIS and JASI in September 2006.

used in his book. In the 1970s Daniel Bell was among the first to develop the "Post-industrial society" theory asking what kind of society will come after industrial society. But it was much later that he started to use a positive term such as "knowledge society" or "information society."

In Japan, the term "Information Society" was created very early. The pioneer was Tadao Umesao, who published an article on "Information Industry" (1963). Then, in the late 1960s, more new terms such as "information society (*joho shakai*)," "information revolution (*joho kakumei*)" or "informatization (*johoka*)" were created one after another by Yujiro Hayashi (Economic Planning Agency), Reikichi Shirane (then at NTT), Ken'ichi Koyama (Gakushuin University), and Yoneji Masuda (former researcher at Manchuria Railway and the author of an English book, *The Information Society as Post-Industrial Society*). By the way, I happened to learn recently that in the *1st Comprehensive National Development Plan* (1969), it was already pointed out clearly that "From now on, it is the era of informatization. We have to be ready to respond to the information society." This means that nascent discussions on informatization in those days were promptly understood and reflected in a formal development plan of the government.

But Murakami still had some doubts, even in his late years, about the assessment of "informatization." He argued that at least two different interpretations can be given to this phenomenon. One is to identify informatization with "super-industrialization" so that it means the "third industrial revolution." In other words, this new "revolution" centering

around the computer industry is nothing but a new "industrial revolution" that follows the second industrial revolution in the 20th century. At the same time, however, Murakami admitted the possibility of another interpretation - that is, to view informatization as "trans-industrialization." If one adopts this interpretation, Murakami thought that informatization could be the process of "post-industrialization" that surpasses industrialization itself. If the latter interpretation is more valid, and if one identifies industrialization with modernization, then "informatization" should mean the transition to post-modernity. But could we really assert that? Murakami passed away before he settled this question.

So I thought I should establish my own viewpoint and decided to adopt a view that information society is society in the "last modern" phase of modernization. That is to say, modernization will continue beyond the phase of industrialization. But then, it can be thought that, modernization had also begun before industrialization. In other words, there was another phase of modernization preceding industrialization. It was in this first phase, the phase that might be named "militarization" or "statization," namely the emerging phase of modernity that the modern sovereign states were given rise to. In this sense we may say that, agreeing with the political scientists, modernization emerged in the 16th or the 17th century.

From this point of view, when we consider the "three waves" of modernization itself, we can argue that the modern society first "emerged" in the form of the militaristic society in the 16th century, then made the "breakthrough" as the industrial society in the

second half of the 18th century and is finally entering its "maturation" phase since the second half of the 20th century as a transition to the information society takes place. I would also like to point out that each phase doesn't necessarily begin after the end of the preceding one, but they overlap to a certain degree. Moreover, we can further distinguish three minor phases in each major phase of modernization. For example, the phase of militarization, which is the "emergence" phase of the modern society, can be divided into 3 minor phases: "emergence of emergence", "breakthrough of emergence" and "maturation of emergence." We can then postulate that the "maturation" phase of the militaristic society itself, which corresponds to the "maturation of emergence" phase of the modern society, actually overlaps with the "emergence" phase of the industrial society, which in turn corresponds to the "emergence of breakthrough" phase of the modern society. According to such a view, we can argue that the industrialization has entered its "maturation" phase since the second half of the 20th century. In other words, the industrial society has entered the era of the third industrial revolution since the second half of the 20th century, but at the same time, this era overlaps with the "emergence" phase of the information society, which corresponds to the "emergence of maturation" phase of modernization. In my view this emergence phase of informatization is nothing but the era of the first "information revolution" that is simultaneously taking place with the "third industrial revolution."

So if I distinguish three phases of modernization, each should be similar in the

sense that they are phases in an overall modernization process and, at the same time, each should have its own uniqueness in the sense that they represent a different phase.

Now, if I focus on the similarities I can say that modernization as a whole represents a continuing process of increasing power of individuals and organizations. Thus in the militarization phase, regional organizations are gradually centralized to form a modern sovereign state, and further, once the process of sovereign-state formation is completed these states launch global expansion (promotion and exhibition of their national prestige) by means of war and colonization. Similarly, in the industrialization phase, economic power is first concentrated in industrial enterprises. Then these enterprises seek global development in the world marketplace by means of accumulation and demonstration of their wealth. Finally, in the informatization phase, intellectual power will be accumulated in newly rising organizations that may be called "information intelprises." Then they will be engaged in what may be called the "wisdom game" in the global "intelplace" by means of acquisition and execution of wisdom. If war was the basic form of interaction between sovereign states and competition was the basic form of interaction between industrial enterprises, then collaboration will be the basic form of interaction between information intelprises in the informatization phase of modernization. I am tempted to posit that one important outcome of the wisdom game is self-accumulation or self-organization of what might be called "intellectual capital" or "intal," just as "capital accumulation" was the main

outcome of the capitalistic "wealth game."

Recently the book *The World is Flat* by Thomas Friedman seems to be widely read. In this book the author distinguishes three forms of globalization: Globalization "1.0", "2.0" and "3.0." In my conceptual framework his globalization 1.0 corresponds to "internationalization" during the statization phase of modernization because the process of modern sovereign-state formation led to the birth of international society. Globalization 2.0 corresponds to the process of world-marketplace formation during the industrialization phase of modernization. Globalization 3.0 of today, which is actually globalization *per se*, will then be interpreted as the process of global-intelplace formation, in contrast to the process of world-marketplace formation. It is through globalization 3.0 in this sense, in which most knowledge will be freely sharable and what I call "intal" will be self-accumulated all over the world with the Internet as the fundamental infrastructure for such a process, that propagation of modern civilization will finally be truly global and modernization itself will reach its maturation (and probably last) phase.

When it comes to modernization, until quite recently it has been taken as granted that social change such as modernization can take place only in Europe, with Japan as the only exceptional non-European case. That is to say, the rest of the world was believed to be unable to modernize. For this reason the central theme of "modernization theory" was to explain why modernization outside Europe was possible only in Japan. But today no one can deny the fact that modernization is

propagating to almost everywhere, beginning with four little "dragons" in East Asia, followed by the BRICS and the "Next Eleven" as Goldman Sachs pointed out. Clyde Prestowitz, who once became famous as the author of the bestseller *Trading Places*, has just published a new book called *Three Billion New Capitalists: The Great Shift of Wealth and Power to the East*. In these newly developing areas, what Chalmers Johnson and Yasusuke Murakami called "developmentalism" has been the guiding principle, particularly among the BRICS countries. At the same time, however, there seem to be many other areas that cannot successfully adopt developmentalism by themselves. We will probably have to work out a new principle that might be called "co-developmentalism" to help or collaborate with them in order to promote modernization of those areas. I would like to talk more about this later.

Having those new issues in mind, I am tempted to argue that if modernization should really propagate globally, it might be worthwhile to review again the process of modernization as well as modernization theories in the past.

For example, how about extending the time-horizon of Umesao's "Ecological View of History"? In his original view Umesao postulated that the modernization process began sometime in the 16<sup>th</sup> century in both Europe and Japan in parallel. But can we not assume that "modernization in a broader sense" started about 500 years earlier, for instance around the 10<sup>th</sup> century, not only in Europe and Japan alone but also in many other parts of this planet? This may suggest that "modernization in a broader sense" first

emerged as "feudalization" that laid the foundation for rise of regionally autonomous powers. The maturity of this "emergence" phase itself (namely, the maturation of emergence) may have been the "statization," or the formation of regional "sovereign states." But then we can also find that, since about 500 years ago, the "breakthrough" phase of modernization in a broader sense had already started with the formation of the "world capitalism system" in Wallerstein's sense. And finally, since the second half of the 20th century as modernization in a narrower sense—that is, modernization led by European states since the mid 16<sup>th</sup> century entered its maturation phase in the form of "informatization"—modernization in a broader sense also entered its maturation phase simultaneously. This is my overall vision of "modernization in a broader sense."

Modernization in this broader sense started, most probably, independently in both Japan and Europe, and then evolved in parallel at both ends of the Eurasian Continent. But this is not the whole story. According to Heita Kawakatsu, an economic historian, we can find that a similar process of social change had also started in the Song period of China, especially in the Southern Song period. He further suggests that the activities of Mongols stimulated both Japan and Europe to accelerate the modernization process that had begun autonomously. That is a very interesting idea. Having those developments in mind, we can even more convincingly assert that, since about the 10th century, both Japan and Europe simultaneously started the process of modernization in a broader sense—that is, the process of "feudalization"—in a

parallel fashion. During the following several centuries, these two modern civilizations in Japan and Europe twice experienced main encounters. The first encounter took place in the mid-16th century. On that occasion, Japan accepted two important civilizational components from Europe: The "2 Gs" of God and Gun. Then in a mere several decades that followed, both faith in Christianity and production and use of guns prevailed among the Japanese people with enormous speed. However, after about 100 years both of them were virtually abandoned or forbidden and Japan and Europe pursued separate paths. In terms of economic development, Europe achieved the "industrial revolution" while Japan succeeded in the "industrious revolution."

In the mid-19th century a second encounter between Japan and Europe took place. On that occasion Japan again accepted two new civilizational components: the "2 Is" of Imperialism and Industrialism. Japan then launched building and expansion of a sovereign state after a European model. Japan also made endeavors to graft European-style industrialization onto its industrious economy by ways of mechanization and commodification of the production process. This time again, within less than 100 years, Japan made great successes in accepting those new civilizational components, though at this time it hasn't yet reached the point where Japan can abandon them. Of course, we may claim that Japan has in fact abandoned at least the first "I" (Imperialism) after having lost the war in the past, but there still remains some doubt about that. On the other hand, with respect to the second "I" (Industrialism),

we have recently been observing a rise of strong criticism or reflection of industrialism not only in Japan but also globally, so chances are that by the mid-21<sup>st</sup> century, Japan or for that matter the rest of the industrialized world also may be seriously considering the possibility of abandoning or at least self-restraining further industrialization. At this juncture, I may also take into consideration some implications of maturation of modernity in a broader sense. During this coming maturation phase I expect that there will take place reevaluations of value systems, namely "culture," that lie behind the modern civilization so that it can take some alternative course of development after it enters the maturation phase.

To consider those issues more fully, I would like to introduce you to two fundamental hypotheses of infosociomics. The first one is a diachronic hypothesis that the birth and extinction of social things follow an S-shaped curve or a sigmoid. That is, if we measure size, or the growth rate, or some other relevant index of a social thing in question on the vertical axis and time on the horizontal axis, we can visualize that it first "emerges" and grows very slowly but then makes a "breakthrough" so that its growth accelerates and finally it "matures," in many cases after some bubble-like overshooting. In this process the bubble blows up and its size is readjusted so that it gains a certain well-established position among other existing social things. After maturation it may keep on surviving for a long time or may eventually decline and pass away.

Moreover, we can imagine that a series of similar social things repeatedly and

successively emerge following similar sigmoid paths. If there occur some overlaps between the preceding sigmoid and the succeeding one so that the former's maturation phase coincides with the latter's emergence phase, we may regard such an overlapping phase as a downward-sloping phase of a "cycle," particularly a "long cycle" that some social scientists claim to have discovered in the process of social evolution. During this phase a "progressive" way of thinking—trying to come to grips with the emerging new phase—and the "conservative" way of thinking—clinging to the matured phase—tend to stand in conflict with each other, which may lead to social turmoil and in some cases political conflicts such as a war or a revolution. In contrast, when there is no overlapping and just one sigmoid is in its "break-through" phase, there is little conflict in understanding the character of the era, or the "Zeitgeist," and the social cycle is in its upward-sloping phase.

But in the next phase of ascending (that is the breakthrough phase of the next ogive), those confrontations are basically resolved and the growth advances in a manner of "Go for it!" In that sense, the diachronic process of the social change may be explained in the form of the repeating long wave. We may also conceive of a situation where one large sigmoid representing a social thing at large can be divided into an overlapping and overlaying chain of smaller sigmoids, each corresponding to "emergence," "break-through," and "maturation" of the larger social thing but itself representing a smaller social thing. We can then imagine a "fractal-like" structure of sigmoids of various orders.

The second fundamental hypothesis is a

synchronic one. It assumes that many classes of social things follow, in terms of their size distribution, the "power-law" or "Zipf" distribution.

Recently the term "long tale" became quite popular, so I think many of you have heard about it. In fact the white paper on Information and Communications for this fiscal year took a special look at that and dedicated a whole column to explain this phenomenon. Chris Anderson, who first coined this term, initially argued that the long tale phenomenon denied the "Pareto Law" or the "Law of 80:20" in business. This Law asserts, for instance, that the top 20% of employees earn 80% of the total profit of the firm they work for, or that the top 20% of best-selling books occupy 80% of the total earnings of booksellers. However, in his new book published this July, he discarded his former claim and instead points out that the long-tail phenomenon is just another expression of the "Law of 80 to 20" or the power-law distribution. This means that power-law or Zipf distribution is a universal law that applies to the business world. Thus, when we correlate the level of revenue and the rank of firms according to their revenues, the shape of the distribution looks like a hyperbolic curve type. Or it is drawn as a downward-sloping straight line on a double logarithmic plane. With this result in mind Anderson notices that the development of information technology is freeing people from the physical and institutional constraints of the past, so that, for example, they can now publish or sell books online that sell only in small numbers and were regarded as unsuitable for publication or to be kept in

stock. In other words, some of the long-tail part that had been cut off can now be realized making the power-law shape of distribution more conspicuous. Of course, I am ready to admit there still remains a lot of room for further discussion and elaboration concerning this hypothesis. But, as a kind of first-order approximation I think now we may safely expect that quite a few social things follow the power-law or Zipf distribution.

To recapitulate my talk so far, I would like to posit that many social things follow these two empirical "laws." Thus, diachronically, they emerge, grow, and perish following S-shaped paths and, synchronically, they are distributed according to the power-law or Zipf distribution. I am also tempted to anticipate that there is some correlation between the value of exponents and the phase of S-shape curves. At any rate, I believe that for Infocionomics to move ahead further research concerning these "laws" are strongly called for.

Let me now add a few more words about the S-shaped curve. As I have said, a social thing can be decomposed into its components, each of which follows its own S-shaped path during its life. Probably we can repeat such a decomposition many times, thus obtaining a fractal-like structure of overlapping and succeeding S-shaped curves.

For example, if we visualize the whole process of modernization with a big S-shaped curve (as is shown in the resume by a thick red line), it can be decomposed into at least three smaller S-shaped curves, each corresponding to the phases of 1) militarization, namely, "emergence" of

modernization as sovereign-state formation, 2) industrialization, namely, "break-through" of modernization as development of modern industrial enterprises, and 3) "informatization," namely, "maturation" of modernization as emergence and spread of what I would like to call "information intelprises" and the "wisdom game" they play. Please notice that I have drawn a decomposed picture so that the maturation phase of the preceding small S-shaped curve overlaps with the emergence phase of the following small S-shaped curve. At the same time, we can imagine a possibility that the "maturation" phase of the overall modernization itself may be overlapping with the "emergence" phase of a new, post-modern civilization. If so, then we can also argue that "informatization" represents overlapping of maturation of modern civilization and emergence of post-modern civilization. Even though I have no objection to such an interpretation, I still would like to emphasize the viewpoint to regard "informatization" above all as the last, maturation phase of modern civilization.

Let me now return to the topic of modernization in a broader sense. If we place the historical process of modernization in a longer time-horizon, we may postulate that modernization started in Japan and Europe in about the 10th or 11th century. It was around that time that the "feudal society" emerged in Europe and the "ie society" was born in Japan. Both of them saw a rise of local, territorial powers that had formidable military power and were highly independent. If we recognize these phenomena as the "emergence" of modern civilization in a broader sense, then the period after the 16<sup>th</sup> or the 17<sup>th</sup> century

during which the building process of sovereign states took place in Western Europe and, in Japan, formation of a centrally united political power that eventually produced "Edo civilization" or "Tokugawa society," could be interpreted as the "breakthrough" phase of the modernization in this broader sense.

It was in eastern Japan that a unique group of warriors emerged and developed between the 10th and the 15th century., They were developer landlords who had mastered the art of arrow-shooting while riding on a horse. They managed to build their own state, the Kamakura state. And since the 16th century the center of new developments shifted to central Japan, where local farmers turned into warriors and built their own regional states (*Kokka*), beating down the existing warrior powers. The Tokugawa state can be seen as a global unification (*Tenka*) of those regional states. In other words, if I follow Kyoji Watanabe's fascinating interpretation of Japan's history (*The Origin of Early Modern Japan*), the Tokugawa state was a state built basically on the parvenue farmer-warriors' power rather than traditional warriors.

Then since the second half of the 20th century, this modernization in a broader sense entered into the phase of maturation almost at the same time both in Japan and Europe. Today, we are becoming aware of similarities rather than differences between the maturing Europe and Japan in lifestyles, new values, and attitudes toward informatization of society. These two regions may be nearing each other even in terms of "culture" so that they value collaboration and sustainment more highly than competition and growth.

If we review again the process of social

changes in Europe since the mid-16th century, in terms of modernization in a narrower sense, militarization or statization that emerged as the rise of "absolute monarchy" shifted into the "break-through" phase in the form of "constitutional monarchy" about a hundred years later, finally maturing as "republican democracy", still another hundred years later. Since then "republican democracy" remains as the global standard for the modern polity. This maturation of statization overlapped with emergence of industrialization, namely, the break-through phase of modernization in a narrower sense. Following this overall trend of modernization in Europe, since the mid-19th century all of Germany, the US and Japan, who were the "latecomers" of modernization in a narrower sense, intentionally adopted the "developmentalistic" policy with the help of which they successfully promoted both militarization and industrialization simultaneously.

But since the mid-20th century, the number of nations or regions admitted to be independent increased very rapidly. Most of them ambitiously attempted to employ "socialism" as the latest version of developmentalistic modernization, alas, without much success either in state-building or in industrialization. No matter how miserable the performances these newly emerged states made in their attempts to modernize, as long as the international society regard it as their sacred right for them to modernize, harbingers of modernization must accept it as their international obligation to help or collaborate with those latecomers so that propagation of modernization takes place

globally. This is, in my view, a new ideal that should be widely shared in this century. I would like to call it "co-developmentalism" and sincerely hope that it will replace the philosophy of "international development aid" in the 20<sup>th</sup> century, which seems to have been more one-sided and selfish.

At the same time, however, I am afraid I cannot deny the possibility that some of the bigger latecomers continue to adopt traditional "developmentalistic" strategies to promote modernization by themselves, leading to depletion of natural resources, environmental destruction, and/or international conflicts. In other words, the 21st century may witness repeat performances of the 20<sup>th</sup> century like the developmentalism principle in the sense that new latecomers first make their best efforts to develop nuclear weapons and only after they have succeeded they launch promotion of industrialization in earnest.

By the way, the 20th century could be seen as the century of developmentalism. The first-generation latecomers such as Germany and Japan who had successfully built modern sovereign states also rose as formidable industrial and trade powers. They then made a case against the monopoly of colonies and world markets by early-comers and even challenged them militarily. That challenge finally turned into a war among the latecomers themselves (namely, US-SU-China versus Japan-Germany-Italy), with the outcome that wars of invasion and colonization (or what I call the Prestige Game among sovereign states), that had been admitted internationally as execution of sovereign rights of the modern states were

deprived of their legitimacy. Since then most states, particularly those first-generation latecomers who lost wars decided to concentrate on industrialization and to make their states economic powers.

Contrary to that, in the 21st century or since the mid-20th century, some of the second-generation states seem to have learnt the lessons of economic developmentalism with which Japan or Germany made a great success again. China and India, which have been showing remarkable economic success these years can be taken as typical examples. However, doesn't this imply another nightmare some decades from now? That is to say, after the success of this new developmentalism, wouldn't it be possible that some of the second-generation latecomers might want to challenge another time the advanced states in some form or other, including something like a cyberwar? This is certainly undesirable. I don't want the world to repeat the tragedies of the previous century. There is some hope, though. That is the rise of a new wave of what I called "co-developmentalism." I believe that we will have to make our best efforts to propagate this philosophy so that we can control the older developmentalism, thus avoiding the clash between the early-comers and latecomers of modern civilization either in the form of all-out war or international terrorism.

So far I have been talking about my diachronic hypotheses. Now I would like to move to the synchronic ones. A graph of the Zipf distribution, which is the distribution of correlation between the sizes and ranks of social things, shows a small number of huge things on the left ("big head" or "short head"),

while the overwhelming majority of small ones is placed on the right forming a "long tail" so that the whole curve looks like a hyperbolic curve. If the graph is drawn on the double logarithmic plane, it becomes a downward-sloping straight line. That means each individual that belongs to this distribution class is homogeneous with one another in the sense that there is no demarcation point separating the "head" from the "tail" on this straight line. So dividing this straight line somewhere and calling one the "head," the other the "tail" is just an arbitrary distinction. If the so-called "long tail" concept is based on such an arbitrary distinction it should be viewed with some suspicion.

But I think such a distribution has a unique use in social science. That is, it can provide an overall view of distributions of wealth, income, and so on in a society. For example, in a pre-modern "class" society, if enough data is available so that one can draw its graph placing its members according to the size and rank of wealth or income on a double logarithmic plane, most probably it will not be a straight line but a kinked line corresponding to the "class division" of such a society. Namely, people were divided into a small number of aristocrats, a middle number of citizens and an extremely large number of farmers, even though the farmer class is represented as only a "short tail" on a double logarithmic plane. In contrast, the central feature of capitalistic modernization (industrialization) was, at least "theoretically," in removing the traditional class distinction and provided an equal chance to participate, if you like, in capitalistic competition on a level-playing field for all the members of

society. However, needless to say, such a homogenization never meant an "equal" distribution of wealth or income. Wealth and income in the modern society are distributed following the "power-law" or Zipf distribution. In this sense, in today's society where there is assumed to exist no institutional class distinction, a big inequality of wealth/income distribution still remains and even seems to be expanding as informatization proceeds. Nevertheless we should note that, in a capitalistic society, people can move up or down along one downward-sloping straight line. The fundamental feature of such a society is that a social environment for "free" competition is formed in which people can go upward to rise or down to ruin. But Karl Marx, I think, thought that in this capitalistic society there is not only a class distinction between bourgeoisie and proletariat but also there eventually develops a further bipolarization as the result of completion, producing just a few monopolistic capitalists on the one hand and, on the other hand, a large number of "lumpen proletariat" who has nothing to lose but an iron chain. That was why he believed that a political revolution by the proletariat was inevitable.

What actually happened in the real industrialized society, however, was not a revolution but a transition to the welfare society. That is, the government introduced an anti-monopoly policy together with a redistribution policy of income and wealth in the form of progressive income and inheritance taxes that were used to compensate incomes of poor people. This policy was effective both in deterring monopolies and in raising the minimum level

of income while reducing its maximum level. As a result, I presume that the shape of the Zipf distribution curve of income in today's "welfare society" came to have two kinks. Namely, instead of being just one straight line, it probably is comprised by three straight lines. This means that a kind of qualitative (class) differentiation was reintroduced among the members of modern society, even though the distribution of wealth and income were relatively equalized. This has certainly been the development in modern society quite different from Marx's anticipation.

In infocionomics, the most prevalent type of social interaction individuals or organizations performs in each of the three main phases of modernization is regarded as a kind of social game. For example, in the militarized society, sovereign states have been playing what might be called the "prestige game," the study of which has been established as the discipline of political science. Then in the industrial society, it was the "wealth game" that came to be widely played leading to the birth of a new discipline of social science called "economics." Together with Adam Smith's *Wealth of Nations* I believe Karl Marx's *Das Kapital* was a monumental writing that deeply analyzed the wealth game.

Similarly, in the information society from now on, we will observe the development and spread of a new social game that I would like to propose to call the "wisdom game," of which the main purpose is, in my term, to acquire and use the power of persuasion, though I also notice that the term "reputation game" has already been used widely. Just as the prestige game acted as a stimulus to the

birth of politics and the wealth game to the birth of economics, the wealth game will also act as a stimulus to the birth of still another social science discipline. I am tempted to call it "sociology." But the term sociology has long been used to indicate the rest of social study fields that have not been covered either by politics or economics. In my humble opinion, however, it is precisely with the rise of a new social game that a new discipline of social science obtains its inherent object of study. So, if I am to avoid the use of an existing term, I would like to suggest "socioeconomics" as the name of this new discipline. Actually, that is why we adopted "Infosocioeconomics" as the name of a new academic society to study the information society where we believe a new social game, the wisdom game, will spread.

Recently, Yochai Benkler published *The Wealth of Networks*, which is no doubt a very important and timely study of the information society. But if I could I would rather write *The Wisdom of Networks*. Or I hope I could be ambitious enough to write something like *The Wisdom-Capital* or perhaps *The Intel* mimicking Marx rather than Smith.

Marx began *Das Kapital* with the phrase "The wealth of those societies in which the capitalist mode of production prevails, presents itself as 'immense accumulation of commodities,' its unit being a single commodity. Our investigation must therefore begin with the analysis of a commodity" (quoted from the English edition). So, on my part I am dreaming to begin my would-be book *The Intel* with a phrase such as "The wisdom of those societies in which the intelist mode of creation prevails, presents itself as 'immense accumulation of sharables,' its unit

being a single sharable. Our investigation must therefore begin with the analysis of a sharable." What I have called "sharables" here are nothing but individual elements of the wisdom of the information society, which are created not for the purpose of selling it but sharing it. In other words, sharables in the information society are not commodities that are produced to be sold in the marketplace. They are freely shared in what might be called the "intelplace," the concrete form of which may be guessed from today's Internet.

And each sharable has its unique "URL" taking the form of a "permalink" that can be directly reachable. It is also linked to and from many other sharables in various ways. There are both "outgoing links" to reach other sharable and "incoming links" to come in from other sharables.

Most probably typing in URLs directly to reach other sharables can be compared to bartering of commodities in the industrial society. Needless to say it is as inconvenient and cumbersome as bartering of commodities. But once the search engine is invented and improved so that one can easily find and reach almost any sharable simply by typing relevant keyword(s) into it, we can compare this way of sharing of sharables to exchange of commodities mediated by money. Namely, in sharable-sharing it will be keywords/search engines that play the role of money in commodity exchange. Thus I presume that the fundamental part of "infosocioeconomics" or simply "socioeconomics" would be comprised by analyses of sharable-sharing both in its direct form (URL typing) and in its mediated form (keyword searching).

In any case, I think one characteristic of the

social order in modern society is that a macro-level order spontaneously emerges out of micro-level social game interactions. If I borrow the words of Wataru Yasutomi and Kunihiro Kaneko, "a certain dynamic equilibrium state is achieved where there is stagnation of order and then it leads to growth of the whole."

Thus during the initial "emergence" phase of modernization, that is, militarization, a general recognition was formed. It was the recognition that if the "prestige game" is widely played following a certain set of rules, there will eventually emerge a relatively peaceful situation where something like a "balance of power" between warring states is achieved, while the power and prestige of each state keeps on growing. Similarly, during the second "breakthrough" phase of modernization, that is, industrialization, it was widely recognized that if the "wealth game" is widely played following a certain set of rules, a wonderful order is created during the game, and there will eventually emerge a relatively prosperous situation thanks to the functioning of "God's invisible hand," where something like a "market equilibrium" between supply and demand of commodities is achieved while the power and wealth of society keeps on growing. For this reason I anticipate that during the third "maturation" phase of modernization, that is, informatization, if the "wisdom game" comes to be widely played following a certain set of rules, there will eventually emerge a relatively pleasant situation (or what Ivan Illich called "conviviality") where something like an "intellectual equilibrium" between supply and demand of sharables will be achieved, while

the power and wisdom of society keeps on growing.

Of course, no social order is perfect. For that matter the modern social order of balance and growth that spontaneously emerges as a result of a social game is no exception. It is inevitably accompanied by such negative traits as an unacceptable degree of inequality in the (power-law) distribution of social powers and cyclical disturbances (such as war and depression) in growth of social powers. Thus it is highly likely that the future social order of conviviality will also have to be accompanied by some kind of inequality (such as "digital divide") and cyclical disturbances (such as rages and doldrums of fashion).

When these negative traits are recognized, intentional efforts to alleviate them will be made in the form of governmental policies, such as the "balance of power policy" or "anti-cyclical economic policy." We may call such policies attempts to "create" desirable social orders.

In fact, in modern society until now, a number of such policies as well as strategies for them have been designed and implemented for the purpose of intentionally and artificially creating better social orders rather than just wait-and-seeing if the spontaneous forces work. Adoption of "developmentalistic strategy," implementation of "structural reforms policy," and collusion for a political "revolution" are typical examples. The very important point to be noticed, however, is that those intentional endeavors do not work out fully, or they are destined to have some limits. After all, we human beings are not omnipotent. I would rather like to point out here that, as a rule, new social

orders that alleviate the defects of old orders spontaneously "emerge" as a result of transition into a new phase in the evolutionary process of modernization. That is, it was economic growth and industrialization that basically solved problems related to human rights. Similarly, I think chances are that intellectual growth informatization will be more effective than today's socio-economic policies in solving or alleviating people's dissatisfaction due to unequal distribution of income and wealth.

In this sense, first, there's some limit in our endeavor to intentionally "create" a better social order. When it comes to solution or alleviation of existing social problems, more promising is "emergence" of a new order. But second, human beings nevertheless will never give up intentional efforts to "create" a better order. Actually, from a higher point of view, the intentional efforts for creation themselves "emerge" both spontaneously and necessarily.

This reminds me of Kozo Uno's three levels of economic theory: "principle," "stage theory," and "present state analysis." In my interpretation, his "principle" means an analysis of the "emergence" of capitalistic economic order that looks to reproduce itself eternally. Such an order transcends the dimension of time. In contrast, his "stage theory" is an attempt to demonstrate that in each phase of industrialization different types of economic policy, or intentional efforts to "create" a certain economic order, are almost inevitably made as if they are governed by a natural "law." And it is only in the last level of his system of economic theory that Uno provides a room for human free will or choice. This incidentally is the level from which Uno

himself abstained as a social scientist and yielded it to "revolutionaries." I think this is very interesting and suggestive.

If we are to learn again from Karl Marx, the most important point in *Das Kapital* is the recognition that the social order of market exchange and capital accumulation is something that inevitably "emerges" beyond intentions and desires of individual capitalists or politicians, governed only by the law of "natural-historical" development of human society. After extensive observations and analyses of this "emergence" process, he not only wondered about and praised its exquisiteness and efficiency, but also pointed out that it is also accompanied by some serious defects, particularly too large inequality in the distribution of wealth and too violent disturbances of the order that cyclically take place as economic crises. Then Kozo Uno, his disciple, went one step further and pointed out that the efforts to cope with these defects themselves "emerge" following natural-historical laws.

Then what can we say about a "revolution"? Does it also "emerge" necessarily following some natural-historical law such as the "correspondence between forces of production and relations of production," or is it a product of human revolutionaries' intentional choice? Uno obviously took the latter view. But I am not so sure about Marx's position on this issue, though we might say that his "materialistic interpretation of history" predicts from, so to speak, the highest viewpoint, the historical necessity of "emergence" of revolutions. It is well known that Stalin took a gray, sophisticated position concerning this issue by saying that revolutionaries perform a revolution by

"subjectively" applying the "objective" law of necessary "correspondence between forces of production and relations of production." But distinction between "emergence" and "creation" can only be made depending on which viewpoint we take to analyze human behavior.

Be that as it may, the final point I would like to make today is that the decisive error Marx made was that he expected that a revolution would be lead by the suppressed masses. That is, he believed that it is the "proletariat" class who occupies an overwhelming majority in the capitalist society that creates the next communist stage of social development. This could be the limitation of the times for Marx who was living in the 19th century when industrialization was only in its emerging phase. Nevertheless I don't understand why Marx overlooked the simple fact that people who lead the "bourgeois revolution" in the industrial society belonged to the citizen class who exclusively embodied the newly rising strong economic power but who represented only a small minority. Similarly, if a political "revolution" is to take place in today's nascent information society, most probably it would be lead not by the "proletariat" of the industrial society but by the

newly emerging social group who embodies the power of informatization, namely, those who are called "netizens." It was because Marx expected the coming of a next "revolution" too hastily before the new phase of modernization arrives that he could only place his hope on the then-existing repressed mass of "proletariat."

Having said that I am also ready to admit that the suppressed mass may sometimes cause a revolution depending on the social situation of the day, but they could never be the promoter of a revolution that cuts out a new phase of social evolution. In that sense they would be more reactionaries than revolutionaries. That is their historical limitation and, at the same time, the limitation of the researchers who placed hope on them. Since Marx didn't know informatization or the rise of the netizens class, his theory of socialist revolution had to be limited in many ways. Considering that, we may come to more interesting interpretations different from Marx's original views on the directions and traits of social changes that are going on today. That is what we, infosocionomists, are pondering a these days.

This concludes my lecture. Thank you so much for kindly listening.



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# Plural Treatments of a Definition of Information

Keywords:

Information Process, Plural Definition, Transformation-ware, Informational Change of Transformation-ware

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## Abstract

The title of the paper is [Plural Treatments of a Definition of Information].

A concept is defined usually on such a proposition that does not include this concept. In this connection, the plural treatment of a definition of a concept is proposed with its application to a way in which information is defined.

Every piece of information is expressed as many kinds of states of a medium in an information process consisting of the system of output, memory, transfer and transformation. The varied systems have a common character, that is, transformation of a specific piece of information. The author calls each system in an information process "transformation-ware", connecting the short word "ware" to "transformation". He considers that information phenomena are extended to a new region, that is, the bio and social world. As a result, transformation-ware is not always difficult to grasp as the case of an instrument in communication.

The following two points are shown as the new results. Firstly there exists generally an information phenomenon in which transformation-ware is changed by the information in the medium. The phenomena are called a "conditional change in transformation-ware" in this paper. Secondly, only the plural treatment of a specific piece of information succeeds in treating a conditional change in transformation-ware.

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## 1. Plural definition

### 1.1 What is plural definition?

Plural definition is a new way of defining the concept the author of this paper recently put forward. As a general consideration on definition, there is one by Aristotle (719-740 and 750-759, Noburo Katou, 1971) followed by another by Frege (Tatuo Fujimura), who is a pioneer in symbolic logic. However, neither of them include consideration of the plural definition. Nevertheless, we can find some examples suitable for the plural definition, if we review the result of the research in individual scientific fields.

For example, Hilbert composed a logical deductive system originating from a number of axioms in his book "Foundation of Geometry". He stated at the beginning of his book the following propositions as an axiom. (12-13, Koushiro Nakamura, 1943).<sup>(1)</sup>

I1 For two points of A and B, there always exists at least one straight line that connects with each of these points.

I2 For two points of A and B, no more than one straight line exists that connects with each of these points.

Following the presentation of this proposition, Hilbert picked up various other expressions. One of them is "Straight lines a and b cross at point A". In order to make this proposition and axiom I1 the starting point for consideration, this proposition and axiom I1 are described as the following for convenience's sake.

A straight line is fixed by two points.

A point is the crossing of two straight lines.

Hilbert used these two propositions as an axiom and constructed his "Foundation of Geometry" leaving both point and straight line undefined, but the author insists the above stated axiom has the following meanings. That is, the axiom defines a point using straight lines and defines a straight line using points. Two concepts, a point and a straight line, are defined through the relation of the two concepts.

These two definition statements are definitely not tautology. In fact, they couple with each other to compose the basis for the logical development of geometry as learning.

A viewpoint of this kind means to take the standpoint that both point and straight line are simultaneously defined through the two correlations between the two objects: point and straight line.

The concept that constitutes the starting point of a logical deductive system like geometry must not contain any ambiguity. Considering this point, it is quite interesting that the concepts of straight line and point that constitute the starting point Hilbert was given, or had to be given, were in plural definition.

There is a problem that all students at the department of physics have to think about when they learn dynamics, and meditate on. That problem is the definitions of mass and force in Newton dynamics. They think over what are specified and how they are specified when they learn that strength of force is given by the multiplication of a mass and acceleration of a material particle indicated by the effect of force, and mass is given by the acceleration of a material particle when it receives the effect of force. If plural definition

becomes widely accepted, this problem is solved. I think plural definition is often required for defining the basic concepts of individual science.

Thus, when  $n$  pieces of concepts are simultaneously defined via  $n$  correlations, this type of definition is called "plural definition".

## 1.2 Purpose of this paper

Not a few of concepts in practical use are plural definition as a result. The purpose of this paper is to make the concept-definition method of plural definition widely accepted, as well as review the author's definition of information from the viewpoint of plural definition, and consider how comprehensive plural definition is compared to simple definition.

The author defined the concept of generation in a paper co-authored with Yutaka Tanaka, which is titled "Generation Character of Nature" (Yutaka Tanaka, et al., 2006). Generation character is what is often called "hierarchy character", which has often appeared in the author's papers about information, but has no direct relationship with plural definition of information.

In those papers, generations are self-referentially defined. That is, it is defined that "Generation is generated from other generation, as well as generating other generation" as an important part of concept definition. This definition indicates generations are actually self-referential concepts. In the next chapter, it is pointed out that the definition sentence of a self-referential concept can be expressed as a plural definition that does not include the self-referential part. <sup>(2)</sup>

## 2. Characteristics of plural definition

### 2.1 Simple definition and plural definition

In the definition of "point" stated in Section 1.1, "straight line" is used, while "straight line" is defined using "points", so if we replace "straight line" in the definition of "point" with these straight line definition sentences;

Point = A crossing of two (or the one fixed by two points).

Or, if we put this sentence a bit more in order,

Point = When there are two (things fixed by two points), it is a crossing of these two.

If we rephrase the sentence this way, this definition is defining point by point, which makes it a self-referential definition. Conversely, if we replace self-referential characteristics with a relationship to some other thing, here it is replaced by the relationship to straight lines, so we now can acquire the definition in Section 1.1.

The author defined generation in a self-referential way in the co-authored paper "Generation Character of Nature". (By Yutaka Tanaka, et al., 2006.) Here generations are the ones often called strata. Also in this case, we can rewrite the definition into a plural definition style that does not include a self-referential part by introducing an appropriate concept.

Thus, when the definition sentence includes a self-referential part, this self-reference can be made into plural and deleted by re-defining this self-referential part as another concept. As a result of the above procedure, the self-referential definition sentence becomes a plural definition, although the number of plural definition sentences must be increased

by repeating the above procedure a number of times when the self-reference is complicated. Also, based on this, it should not be a problem if we assume the plural definition sentence does not contain a self-referential concept. Recently, the author presented the definition of information in plural style. In Chapter 3, the author will review whether this definition has the content appropriate for plural style, and in Chapter 4, he will show concretely that a plural style definition makes it possible to define information that has a broader informational phenomenon compared to a corresponding simple definition style.

### 3. Plural Treatments of a Definition of Information I

#### 3.1 Terminology

First, I would like to mention terminology.

In this paper, the term "transformation-ware" is used instead of the term "field for information process", which was previously used. Reasons are stated below.

Input-output system, transmission system, transformation system and storage system are all systems that transform information. Accordingly, the author has called all of these the "transformation system" and has further named them "field for information process" when a single system or a number of systems satisfy both conditions of definition and stability.(3) Although this term of "field for information process" gives the impression that it is an attachment of information process, there are more points that need attention.

As many people point out, the range of information is quite wide, including from biological to social information. Considering these reasons, the author has changed the

being "field for information process" to "transformation-ware".

#### 3.2 Plural treatments of a definition of the information and external proposition

Three definition sentences 1 The author presented three propositions separately that define information in "Definition of Information". (Hajime Tanaka, pp.10-11, 2004). They are put in order and shown below. In a paper in 2004, the author used this term of plural definition in one place (Hajime Tanaka, pp.2, 2004), but called it mutual limitation or plurality. In this chapter, the author explains the reason why the term plural definition was set aside, as well as considering plurality in more detail. Here, plurality means characteristics of plural definition. Now in the following, the definition of information that was presented in the paper above is put in order and listed.

- A Information is a distinction with a dual expression in the information process.
- B Information process is composed of information and transformation-ware.
- C Transformation-ware is a definite and stable system composed of singular or plural number of transformation systems.

Terms in definition sentence A The unusual phrase "a distinction with a dual expression" is used in definition sentence A above. Although the author has explained this phrase many times in his paper (Hajime Tanaka, pp.4-5, 2003), he dares to repeat the explanation here.

Since it is thought that the last part of this phrase "dual" is rather difficult to understand and had no direct relationship with the description of this paper, I will skip this part

and explain the rest of the phrase "a distinction with a expression".

Information is always expressed in the media and each piece of information is different in actual expression. For example, the three colours, red, green and amber express three pieces of information: stop, go and wait. None of these three colours has to be red, green or amber a priori. Since red attracts more attention, it was thought most appropriate for keeping safety and would have been made to correspond to "stop".

It could be any colour from the viewpoint of informatics. It was fine as long as the colours used for the signal were distinguished from each other. Therefore, we can say the relationship between the content and colour of the signal intended to be transmitted is nothing more nor less than the distinction of content being expressed as the distinction of colour. This can be generally said with regard to information in the information process. A straightforward expression of this kind of recognition is the proposition that information is a distinction expressed in the information process.

Three definition sentences 2 "A distinction with a dual expression" in proposition A, "transformation-ware" in proposition B and "definite and stable system composed of singular or plural number of transformation system" in proposition C are not decided by plural definition as above; in contrast, they are external propositions that give content to plural definitions. If we call them external propositions A, B and C, the above stated plural definitions become as follows;

A Information is external proposition A in the information process.

B The information process is composed of information and external proposition B.

C Transformation-ware is external proposition C.

As you can see immediately if you take a look at those three definitions, the relationship between information and information process is plural, and transformation-ware is specified simply by external proposition in a simple sentence style. Next, let me consider the reality of mutual limitation between propositions A and B according to the content of the definition sentences.

In definition C, transformation-ware is specified as an external proposition. As a result, transformation-ware is specified firmly irrelevant to the plurality between definitions A and B. Therefore, transformation-ware remains as specified by the external proposition in the information process defined by definition B.

As a result, the condition given in definition A is expected to guarantee the plural definition that information is in the information process, though that condition becomes a dummy statement. Since transformation-ware is given as an external definition C, transformation-ware does not change even in the information process and it is transformation-ware itself as specified by external definition C. Furthermore, information is expressed solely with transformation-ware. Having considered the above, definition A can be replaced with definition A' as stated below.

A' Information is an external proposition A on transformation-ware.

Definition group A', B and C with definition A replaced with definition A' is no longer a

plural definition. Therefore, neither do definitions A, B and C possess the substance of plural sentence, which is plurality.

As clearly shown in the explanation above, in definition A, B and C plurality is emasculated, because of a strong regulation given by external proposition.

So, can there be any instances where plural definition deserves its name as being plural? The next Chapter 4 answers this question. Here, I would like to point out that firm regulation of external proposition disappears by heightening plurality of definition.

Together with that, unless it is shown that types of plural definition grasp information phenomena in more detail, plural definition ends up being just a dummy statement without significant meaning for informatics. As described below, there exist widely amongst information phenomena those that can only be specified by plural definition. That means there exist phenomena that transformation-ware, commonly believed not to change in the information process, are varied by information and that kind of information phenomenon is quite common, and in this paper, this phenomenon is called "an informational change of transformation-ware". The above is shown in each chapter after Chapter 3.

## 4. Plural Treatments of a Definition of Information II

### 4.1 Metabolic control

Here, we will take a look at the metabolism of creatures as an informational change of transformation-ware.

There exist in a cell many metabolic routes carrying composition and resolution. Those metabolisms are receiving an artful

adjustment. It is known that one of the representing functions is that a product of metabolism controls enzyme activity responsible for the first step of the same metabolism. This should be one of the examples of how transformation-ware, comprising information process, is changed by the information output from the said process.

### 4.2 Conditioned reflex

As well known, conditioned reflex is a biological reaction first discovered by Pavlov and is the most basic and typical type of learning (Nobuaki Tsukahara, 1998), which is controlled at the level of the neurological cell as found in the study by Taketoshi Ono, etc., for instance (Taketoshi Ono, etc., 2003). Here, in order to review the famous first experiment by Pavlov, let us take a look at the explanation by Nakahara on the experiment by Pavlov.

Pavlov performed an operation on a dog to make it possible to measure the amount of saliva secreted (saliva fistulae), and gave the following stimulus making saliva secretion as reflex. First, the dog was given a stimulus that had no relation to saliva secretion (for example, the sound of a bell). No saliva secretion was caused by this. Next, it was given food after repeatedly ringing the bell. This is called "unconditioned stimulus", because food always causes saliva secretion. Shortly, saliva secretion is caused by the sound of the bell only, because the sound of the bell and food are linked. This saliva secretion is called "conditioned reflex" and the sound of a bell is called "conditioned stimulus" (CS for short). And the repetitious combination of bell sound and food in this

experiment is called "intensification".

The phenomenon of conditioned reflex is not only seen in dogs. It is also conditioned reflex when carps gather to the clapping of hands resulting from giving food simultaneously while clapping hands, and it is a basis for general actions of learning, including those of human beings. What we need to be careful about is new neurological system as the following is always formed at the time these conditioned reflexes are generated. That is, there, nerve fibres that transmit necessary nerve pulses to the part of the brain related to biological reaction of unconditioned reflex and any given conditioned stimulus are connected via unconditioned stimulus. Here we can find a new combination of nerve cell groups. This formation is a generation of the nerve system that was brought by the information(4) based on external conditioned stimulus, which can be said to be the informational change of transformation-ware.

One of the characteristics of human conditioned reflex is that language becomes a conditioned stimulus. So we can say formation of conditioned reflex in the case of human beings is a conspicuously varied informational change of transformation-ware.

Conditioned reflex is widely seen in the animal kingdom, and informational change of transformation-ware is also a phenomenon widely seen and which is continuously progressing.

As evaluated in Chapter 5, it is thought the weight of the phenomenon of informational change of transformation-ware increases more in a social information phenomenon.

#### 4.3 Making a proposition into plural definition completely

In definitions A, B and C, transformation-ware appears as an external proposition. Under definitions like these, transformation-ware remains specified as external proposition, and if transformation-ware changes during the progress of the information process, it expands beyond the original definition. It is impossible to foresee this expansion and include it in the definition, because we cannot assume information to be input to the information process. Actually, unless we make this assumption, we cannot say definitions are sufficient, but in order to do so, the assumptions need to be made stipulatory along undiscovered information process ranging from information phenomenon on the living body to that on our society. It would be rather childish to argue the possibility of that assumption.

So I would now like to revise definition C as a plural sentence and place it along with definitions A and B. And external definition A, etc. are stipulated and shown here.

- A Information is a distinction with a dual expression in the information process.
- B The information process is composed of information and transformation-ware.
- C Transformation-ware is a clear and stable system composed of singular or plural number of transformation systems in the information process..

If definition C is altered as above, the transformation-ware is not fixed but becomes variable, correlating with the information process. I am saying again that this situation is within the range that definition C specifies. If I rewrite all of these definitions, using external

propositions A, B and C, they should be:

- A Information is external proposition A in the information process.
- B The information process is composed of information and transformation-ware.
- C Transformation-ware is external proposition C in the information process.

These definition formulae are really beautiful and clear. Mutual limitations between information, information process and transformation-ware are simply expressed in this style. I would like to explain that definitions as above include change of transformation-ware in the following.

The second Japanese paper is being printed, where the author, K. Nakatogawa and H. Nagata treats the plural definition with the symbolical logic (Hajime Tanaka, et. al., pp.5-12, 2007).

There have been many definitions of information since the 1950s, but all of them might have made definition A' as the definition of information, adding some inventions to external proposition A.

## 5. Transformation-ware in a social information phenomenon

### 5.1 Value standard

Change of values In order to consider informational change of transformation-ware in a social information phenomenon, the author is stating one of the social phenomena experienced by himself. The author has one clear experience even now after 60 years have passed.

It was a belief for most Japanese and the standard of each individual's value judgement that everything should be subject to the

Emperor till near the end of the Pacific War. For the author himself, it seemed like a true belief for many people.

Needless to say, it is not true at present. After the end of the Pacific War, the values of Japanese changed drastically in a couple of months. Thus, there exists a social phenomenon that value standards affecting strongly each individual's daily lives can change uniformly within quite a short period.

The basis for each individual's value judgement is the value standard. It is an important base composed of transformation-ware of each individual's value information process. A social phenomenon as above is exceptional, but values for individual and organization are always changing and various scales of informational change of transformation-ware are in progress behind them.

About transformation-ware It is totally impossible to clarify the details of informational change of transformation-ware in the social information process. Needless to say, we may possibly get a certain conclusion on consideration based on discovery acquired from more advanced brain science. However, not a few factual recognitions, that look certain even at present, exist in our hands, and there are some model considerations that explain well our daily experiences. Inferred results acquired from the content of these factual recognitions and model considerations are the first steps for scientific recognition, and we may be criticized for taking a non-scientific attitude if we abandon these. As one of the examples of model considerations, we may be able to raise the research process theory stated in the next section (Hajime

Tanaka, 1988) or the like.

Most human and organizational intelligent activities are supported by factual recognition and value judgement. A framework of factual recognition and value standards for value judgement are an important part of the individual's and organization's transformation-ware, and both of these may keep changing in accordance with external information, sometimes rapidly and sometimes slowly.

In this paper, I would like to continue considering paying attention to a value standard that is thought to be one of the important components of transformation-ware. Below is one of the reasons.

Value judgement in conversation and scientific research Although I pointed out the below in the paper on tripartite talk (Hajime Tanaka, pp.47, 2006), utterance based on value judgement has a high weight in our conversation. This is not peculiar only to people's daily conversation. As discussed in the above, value judgement has quite a high weight in scientific research, that is, at the opposite end. First of all, hypothesis verification, which is a conventional method for scientific research, is not a theoretical process, but a value judgement process as we considered (Hajime Tanaka, pp.28-30, 2002)

Condition of value judgement A standard of value judgement or, more broadly, standard of judgement becomes a self-referring definition in information we output. Therefore, we may be able to think that value judgement is the base for information process inside our brain and is an important component of transformation-ware. Here I would like to confirm what the change of transformation-ware is, although it seems quite clear, for the

sake of following discussion.

If the content of the value standard for transformation-ware changes only by functioning once, can we call this situation "value judgement by changed value standard"? It is rather doubtful. This case may need to be recognized as the information phenomenon of multiple pieces of information, which are able to influence the value standards and the information to be evaluated, rather than as the information process of value judgement by value standard.

Even in this case, we can comfortably recognize the phenomenon stated above as a value standard of information-ware, when the changed value standard exists longer than a couple of milliseconds, which is the time necessary for brain cell reaction, and always stays in the condition of stand-by, in order to make value judgement.

In the following section, I would like to consider a part of the research process. This phenomenon is a small-scale information process but because of this, we can make more concrete considerations.

## 5.2 Evaluation in research results

Research process The author has published research processes often (Hajime Tanaka, 1988), (Hajime Tanaka, 1997), (Hajime Tanaka, 2002). In the second paper listed, research process theory, designed to be based on research in the field of natural science, was recomposed to make it applicable to research in the field of social science and cultural science.

Although every researcher has experienced research process, in the following, the author would like to show that one of the important

processes cannot make any progress until it experiences informational change of transformation-ware. In order to do so, the stages that have direct relationship with informational change of transformation-ware are shown in Figure 1 and consideration should be based on this figure.

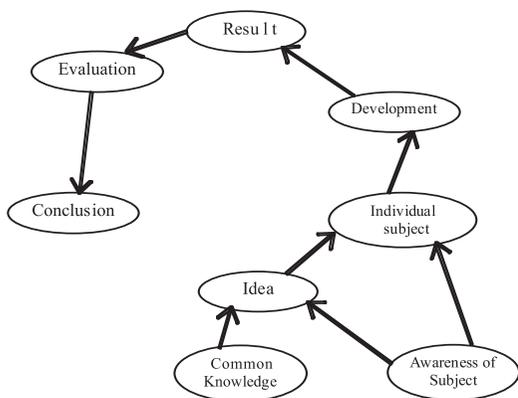


Figure 1 Research process, conclusion from individual subject

The individual subject in Figure 1 is usually called "research subject". In research process theory, a specified research subject is established as the starting point of the research process, and it is called "individual subject" when it is distinguished by a certain number of conditions. It should not cause any problems if the individual subject is renamed "research subject" here.

All procedures made in search of solving the individual subject specified, such as investigation, observation, experiment, calculation and logical consideration, are generally called "development". It is because every one of them is a consideration, behaviour or action seeking a result from resolving an individual subject.

Effort for development will bring a situation where a result is attained. It seems that research has settled for the time being with this, but the opposite is true. We should rather say true research starts from this point. There comes a turn for informational change of transformation-ware, which is the subject of this chapter

Evaluation and conclusion The purpose of research is generally declared by an individual subject. The individual subject has an awareness of the underlying issue, and when a clue for how to proceed with research is found, development of the research starts. In research process theory, awareness of issue is called "awareness of subject" instead, and awareness of subject turns out to be the individual subject when it gets an opportunity for development. I would like to note again, the purpose of this research is to satisfy the requirement of awareness of subject and individual subject.

Therefore, what we need to do next is to evaluate how closely the result attained satisfies what awareness of subject and individual subject require. In other words, we need to evaluate the result from the development, using awareness of subject and individual subject as value standards. This is to evaluate the result by a value standard composed of awareness of subject and individual subject. This value standard is an important component of transformation-ware in the research process.

There should be just a few cases(6) when evaluation based on value standard of research process is not necessary, except the research result of a copper-steel type research(5).

There are often cases when the result attained is known to answer what awareness of subject and individual subject require only under certain conditions. Specifying those conditions is also an important task in concluding the research process. A process where these tasks are performed is the Evaluation in Figure 1.

When result is evaluated, it is called a conclusion. When the conclusion is reached, this research process also terminates.

**Value standard** A value standard in the research process often appears. It first works as selection standard for a number of methods effective for development. And when a result is attained, it functions as a value standard for the value judgement of this result. If the attained result conditionally satisfies the value standard of the research process, it works as a standard to judge the appropriateness of those conditions. Finally, the value standard for the research process compares and evaluates the result attained and itself; sometimes it insists that even the individual subject or awareness of subject should be changed. The value standard for a research process makes a self-denial of its being a value standard depending on the content of the result. These procedures are shown in Figure 2.

In summary of the above, the value standard for a research process is formed at the birth of the individual subject and it often functions toward input information of the result. If we note these, this formation of value standard and its diversified function might be an extremely fine example of transformation-ware's informational change.

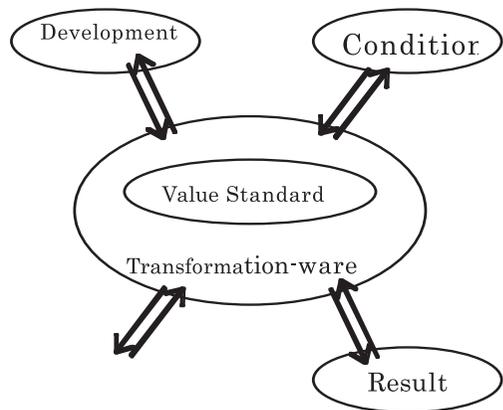


Figure 2 Value standard in research process

### 5.3 Informational change of transformation-ware in society

**One question** In this section, the author will describe how the basis for a social information phenomenon is informational change of transformation-ware of that society, based on his argument in the previous chapter.

Here, one question might occur. Even if there happens to be an informational change of transformation-ware in the research process, the ratio the research process occupies in the information process of the whole society is low, so that if any conclusion is reached from the research process as an object, its weight in the social information process should also be low, which leaves us a question whether, in the end, informational change of transformation-ware might just be an irregular phenomenon.

**Recognition process in daily life and research** At the end of Section 4.2, the author replied in advance to the question above haughtily "It seems the weight of the phenomenon which is an informational

change of transformation-ware increases more in the social information phenomenon", though, where is the basis for this kind of bold opinion?

In order to answer this, let us pay attention to the scientific recognition process which gives us the impression that it is far apart from our daily recognition process, in order to compare this scientific recognition process with the recognition process in our daily lives. To complete this totally, the author would need an enormous number of pages. Here, attention is given to two basic situations.

**Change of viewpoint** When we encounter an unknown object we have never seen before, we take it in our hand, rotate it and stare at it by tilting it, if the object is small. If the object is too big to pick up, for example, when we first encounter certain buildings, since we cannot move the building, we bend our own bodies and eventually make observation with our heads keeping as low as the ground between our legs. We certainly combine the results from transferring one frame of reference and another, trying to grasp the whole picture.

In research on elementary particles, approach is made to recognize the research object by comparing coordinates of the same object viewing it from different frames of reference.

The method of recognition in our daily lives is common to the modern recognition method in the theory of elementary particles that is regarded as highly advanced, which is quite interesting.

Next, I would like to consider hypothetical verification, which is a representative method for scientific recognition. As stated before,

hypothetical verification is to introduce a certain deduced result from hypothesis in order to get some knowledge from the research object. The hypothesis set up is regarded as correct when this deduced result is recognized as correct in some way, that is, when the deduced result is verified.

Let us review some of our behaviour in our daily lives. When we purchase certain daily utensils, we try them in order to know if they work properly. If I describe these series of behaviour logically; i) Presuming the utensil works normally. ii) If this hypothesis is correct, our purpose is achieved by operating the utensil according to the procedures in the attached manual. iii) The purpose is achieved by operating it according to the procedures in the manual. iv) Therefore, the utensil purchased works normally.

How much difference exists between hypothetical verification on scientific recognition and this series of behaviour? The basic structure of the recognition process is completely the same for both.

In scientific research, method and range used for verification are far from daily ones. Sometimes the range of research is wide and large- scale, or quite often the equipment necessary for verification is extremely large-scale and precise, which costs enormously for their production and installation. These methods for investigation and observation definitely are exceptional actions or behaviour in our daily lives. However, the basic structures of the recognition process correspond with each other and we may be able to find apparent correspondence between the recognition process in our daily lives and in non-daily activities such as scientific

research.

If we are allowed to think of it that way, an apparent fact found in the research process, that is informational change of transformation-ware, is a continuously repeated phenomenon on the basis of the recognition process in our daily behaviour and actions, as well as the non-daily ones.

As for the organizations composing society, there are various levels of them starting from kinds of associations to organizations supporting education and industry, and further to a variety of national organizations connected with political administration and judicature. All of them recognize various facts and decide on certain behaviour and action or the will for them, based on this information. Each organization always has its own value standard. These value standards are also important components of that transformation-ware each organization has, and they change their value standard based on various information. As a result, an extremely dynamic situation of the social informational phenomenon becomes apparent.

## 6. Consideration and conclusion

Consideration Research objects and research method are usually picked out as the conditions that characterize each scientific field. "Research object" for various sciences until the 19th century was the existence grasped by the senses. I will call this "direct object". What are caught by senses through investigation and measurement, and their components are included in direct object.

Here, different individual sciences have rarely shared their proper research object.

Thus, after recognizing the direct object has settled down for a while, especially from the second half of the 20th century to the 21st century, a new situation has rapidly developed. There appear many fields that make an "object based on viewpoint", that is a viewpoint object, instead of direct object, as their research object; for example, cultural anthropology in the humanities field or mathematical science such as fractal science in the natural science field.

As a result, it has become possible to grasp different objects in a cross-sectoral manner, which has made the content of recognition on objects much richer but has caused a new problem. It is the mutual overlapping of research areas for newly born individual science. Possibility of this overlapping sometimes causes confusion in the development of each individual science.

However, the research situation, with complication from appearance of new fields and these confusion, is not simply a confusion but a necessary process during the development of each science. These results of various individual sciences based on a variety of viewpoints may reach unified recognition with a multi-dimensional structure at a certain point. It is because there is only one real world that is the object for recognition.

Without standing at the viewpoint above, there may be a possibility of wandering in the wilderness of confusion if one searches for what is the socioinformatics while dragging the illusion from 19th century "science".

From this kind of viewpoint, what should be done now for development and formation of the socioinformatics becomes apparent. It is to configure a recognition system for social

informational phenomena based on a clear viewpoint and to make it as socioinformatics. Needless to say, there should be multiple socioinformatics that have different viewpoint objects.

Based on the above, I would like to state my conclusion.

**Conclusion** As indicated in the evaluation in Chapter 5, informational change of transformation-ware exists widely in the area from biological informational phenomenon to social informational phenomenon and is an important phenomenon that composes the basis for each information process. This is the first conclusion of this paper.

The first conclusion that requires a definition of information includes informational change of transformation-ware. As the result of the first conclusion, definition of information must follow the plural definition method and the concrete example shown is the second conclusion.

Previously, two types as below have been recognized concretely as the relationship between information processes. The first one is the only relationship in which output information from the information process becomes input information of other singular or plural information processes. And the second one is the nested structure of the information process (Hajime Tanaka, pp.6, 2003). Nested structure is to have a smaller scale information process as a component of a larger information process (7). Since input system, memory equipment and storage system are information processes themselves, the information process usually has a nested structure.

The first conclusion as above implies the

existence of a relational method in that output from one information process changes the information process of itself and others. This is the third conclusion.

Now, as the evaluation at the beginning of this Chapter implies, showing a viewpoint object concretely is the current task for socioinformatics. At the present stage, there should be plural viewpoints of that kind. One of them is as below.

The author has given consideration to information together with the information process since long ago (Hajime Tanaka, 1997). Touru Takahashi also emphasizes that the information process is basic when evaluating social information process (Touru Takahashi, 2004). Natural extension of this viewpoint based upon various considerations that have been developed in this paper is the author's viewpoint.

The social information process is a phenomenon that is woven by various numerous information processes and their mutual relationships. This can be said to be socioinformatics' viewpoint of the social informational phenomenon. Socioinformatics is a science of social informational phenomenon based upon this kind of viewpoint. This is the fourth conclusion of this paper.

#### Acknowledgements

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encouragement for this work, and also helped me a lot with the English abstract. Youko Kawai and Masanobu Wada deliberately reviewed my manuscript and pointed out many errors in my wording for this paper, as well as giving me precious comments. I would like to express my gratitude by stating them here.

#### Note

- (1) In 2000, the old version of the translation by Koushirou Nakamura was published by Chikuma Shobou with a commentary by Chikara Sasaki.
- (2) Self-reference sentence sometimes includes paradox of Crete. However, if proposition P does not contain the kind of paradox in self-referring proposition of "Information is proposition P", this proposition does not include this kind of paradox either.
- (3) Here, "clear" means input/output point for information process is clear, and "stable" indicates that if the information input is the same, information output is also the same (Hajime Tanaka, 2003, pp.6).
- (4) As I already pointed out (Hajime Tanaka, 2004, pp.10), categories of things are also expressed as distinctions and, in this sense, they are information. The term "information" here also includes this kind of meaning.
- (5) Applying research-experiment method or conditions using copper as the specimen for an experiment using iron, not changing those method or conditions, is sometimes called a copper-steel type research, rather ridiculing it. However, these kinds of research are sometimes necessary. They are necessary, for example, when there are no other methods and all specimens or all the experiment conditions within a certain range need to be studied

thoroughly.

- (6) There is a case when the basic subject is different, although awareness of subject and individual subject are same. In reality, the basic subject can also be added to the value standard. In this case, even though awareness of subject and individual subject are the same, the value standard is different. Refer to the paper by Hajime Tanaka (1988) for clearness and basic subject.
- (7) When output from a certain information process becomes the input to other information processes, each information process is nested in larger scale information process which is the total of each information process. Therefore it seems that a nested structure is suitable enough for relation with the information process. However, since it seems that relation of the information process, based on information output and input relationship, becomes the basis for network structure, this relation is recognized as being independent.

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# Supertemporal and Temporal-constrained Characters of Socioinformatics

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## Location of the problem

Almost at the same time as the foundation of the two Japan Socioinformatics Associations in 1996, I suggested an understanding of Socioinformatics that was different from the mainstream one. The latter understood Socioinformatics to be a new academic area that started from journalism, and then developed into a study of mass-communication including radio and TV broadcastings, and is newly a series of studies in, so called media communication theory which analyzes various packaged media, portable information devices such as mobile phones etc., broadcasting and communication satellites and the internet.

On the other hand, my Socioinformatics focuses on the biological revolution that started as an elucidation of DNA information by Watson-Crick, spreading to all areas of life science and bioscience, and which began to develop in biotechnology or bioengineering based upon this spread. This biological revolution in the middle of the 20th century is a huge crustal movement in science that follows the physical evolution in 17th century and it is the academic form that aims at the

*recognition and designing of a study of information and sign phenomenon that has material = energy phenomenon (hereinafter called only "material"), which was established by material science (physics and chemistry) since the 17th century, as an indispensable supporting condition and an unavoidable constrained condition.* It was a big breakthrough in science history which I was named "informatics' theoretical evolution of modern science", "second scientific revolution in capital letters", or, simply put, "new scientific theory". The vitalism, which was recognized as completely lost against physics' reductionism, has revived symbolic informatics as bioscience in a modified form. I tried to introduce and establish the framework of informatics and semasiological theory, similar to the one in bioscience or biological science.

However, in order to do so, I must prepare by giving careful consideration to several factors, in which the whole of nature, consisting of three layers; material, living creatures and human beings, is recognized as the Universe of Discourse. In so far as recognizing the whole nature as the Universe of Discourse is concerned, they can be termed

*philosophical consideration.* I give 6 main examples as below. The first one is the framework of "*pan-evolutionary history theory*" which includes all of cosmic evolution where no sign exists, or the evolution of human beings to which symbolic signs are related. The second one is the revolution of semiology, which is called "*sign evolution theory*" that started from neurological signs and reached linguistic signs using RNA and DNA as prototypes. The third one is the "*new existence theory*" that started from the "generation and existence of the material layer that is generated following material scientific theory" and reached "human formulation and existence that is formulated by human programs (symbolic or signal programs)" via the "biological formulation and existence formulated by the biological program (signal program). In other words, it is the *evolution in existing type from materialistic "generation existence" to biological and human "formulation existence". In other words again, it is the comparison in evolutionary history between (principle) "generation philosophy" in the material layer and (programmatic) "formation philosophy" in the biological and human layer.* The traditional dichotomy of "machine theory vs. organic form theory" means the organic forms can't be built without the inherent signal program (design drawing inside the system), but the machines cannot be built without the external symbolic program (the design drawing outside of the system), except the automatically controlled machines. That is to say both the machines and organics are a formation existence with the difference in design drawings being that "external and symbolic character" vs. "inherent

and signal character", and both are different in terms of style of existence from "generation existence" which depends on the principle rather than on the program, like the cosmic, galactic or solar systems. The accepted theory of defining the modern science as "mechanical" should have been said wrong. Only "structural existence" that carry through from cell to biologic bodies and to the social structure includes command, recognition and evaluation. The sign information function doesn't exist inside or outside of "formation existence" or material layer. Genome science has made it clear that the cell is the basis of the sign information (DNA and RNA) inclusive system in evolutionary history. Now the system is divided into three types, which are "sign information non-inclusive type", "sign information inclusive type" and "sign information externality type". The fourth is the difference in methods of explanation between material science and the bioscience and human science. On the other hand, there are 1) clarifications in the biological and humane program and initial conditions (context functions), 2) the resolution of "adoptive selection by certain selection standards and the border and initiative condition", which is *the explanation and prediction with the dual steps, original to the biological and human layer.* The fifth point is that the so-called theological laws (hereinafter stated only as laws) separated from empirical laws which are the eutaxy principles that apply only to the material layer in nature. The eutaxy principle for the biological layer is the program of signal character, and the one for the human layer is the program of symbolic nature. The program is not a law but the eutaxy principle is

different from law. Referring to the difference between the characteristics of the three eutaxy principles, they are, respectively that *the laws in the material layer are "unable to change and disobey", the signal (signal nature) programs of the biological layer also are "able to change and unable to disobey", and the symbolic (representative) programs of the human layer are "able to change and disobey"*. On the other hand, the eutaxy generalization proposition (hereinafter stated as the eutaxy principle) is found in all academic ground, and in principle, is given as the composition effects of principle and/or signal program and/or symbolic program and each border/initial condition (context functions). It must be said that it is the fundamental collapse of the monism of "eutaxy principle = law" since classical mechanics. I positioned this as a "revolution of eutaxy principle". All the statements made by the mass-communication media insisting that they're "laws" of human phenomenon, are "programs" or empirical law. *The eutaxy principles that modern economics calls economical laws should be recognized as economically rational programs or the mathematical formulation of their synthetic/multiplied effects on the pretext of homo economics*. Since both the laws and programs can seek mathematical formulation, their being formulated doesn't mean they are laws. *The eutaxy principle encompassing such things as behavior styles, orders or rules original to the human layer, were unable to be positioned using a more fundamental framework under the monism of laws of the old scientific theory. But they attained their proper space in the scientific image of the world for the first time in history,*

*with the new concept of eutaxy principle revolution that is "the laws → the symbol program"*. The Universe of Discourse with which we discuss and understand the behavior style is separated from the human layer and is disengaged, expanded and generalized. It is not an exaggeration to say it as a big inversion for the unification of material science, bioscience and human science. Until the emergence of the expanded interpretation of information and sign categories, both the autistic constriction of the visual field of the humanities and the reductionism of science have combined to make it unavoidable that the humanities and science are dissociated and separated. The 6th at the last is that *information is divided into two groups; "non-sign information" and "sign information", and the former is the "general (temporal/spatial and qualitative/quantitative) difference/pattern of the materialistic phenomenon" that penetrates the material layer/biological layer/human layer in nature. The latter is defined as "differences/patterns being signalized that are specific to the biological layer and the human layer*. Succeeding Aristotle, non-signal information is the "general eidos" and signal information is the "signal eidos". Plato's idea is example of signal information. But in my actual experience as vice chairman at the Science Council of Japan for the 18th period, those argument points in the above are all unacceptable ideas in the common subjective world of the present academic field. I can only put my hope on the researchers of the next generation.

Thus it can be said that those three, the "material", the "material transformation" and

the "nomological formation" are basic categories of material science. But *the fundamental categories of biological science and the humanities-social-science are those three; "signal information", "transformation of signal information" and "programming information"*, and by handling two steps of the signal morphologic revolution (separated from the signal media revolution as stated in the following), biological science that handles formation by signal information, such as genetic information, sensory/kinetic information, and human science that handles the formation by symbolic information, such as symbols and languages, are differentiated. Furthermore, the program is an example/one part of sign information, and the program operation is also one example/part of sign information transformation, but they are specialized and extracted concept formations from the viewpoint of the order formation.

#### The supertemporal informatics

By the way, same as with biological science, that has genomics and the protein-science as its core, and includes a supertemporal one that has all of life's history for nearly 40 billion years within range and the specifically temporal one that connects itself with the various biotechnologies inseparably based on the former one, socio-informatics should also include and integrate the supertemporal one and the temporally constrained one. First, in terms of supertemporal socio-informatics, I'd like to limit myself to the simple consideration of the linguistic program in particular, among the three big categories of sign information, and

sign information transformation and programs, given time constraints and the scope of this paper. Considerations are given on three subjects; *the types of linguistic programs, their operations, and their differences and selections*. First, there are enormous varieties of linguistic programs, different from the DNA program (hereinafter the program is stated as p): 1) the individual and concrete p; p of here and now, and the general and abstract p; ethics and laws. For example, from the ad hoc and ad lib programs to institutional programs such as cabinet orders, ministerial orders and ordinances, 2) the p that responds with three modes of sign information functions which is instructional p; to the self and others, the cognitive p and the evaluative p, that is method and steps of instruction, cognition and evaluation, 3) The indigenous p and planned p, 4) The standardized and non-standardized p, 5) The p easy to be verbalized and difficult to be, 6) p that introduces the motive or behavior before/during itself and after, and 7) as the examples of important p difficult to notice but detected by ethnomethodology, p that refers to the program on its own behavior before, during and after the mutual behavior scene; etc.

Secondly, while the operation of p, that is of DNA and, sensory/mobility, is based on material science laws, and generally is unambiguous and unable to disobey, (note that though there are sometimes malfunctions, the operation of linguistic p itself is mediated by symbols, though it is necessary and unavoidable for the assistance and limitation of the biological programs of material science laws and of DNA etc.) it should be said rather that the *"ambiguity of interpretation" and the*

*"possibility of deviation" are normal.* The operation of linguistic p is just the "construction" of the various systems on the human level, and the so-called constructionism of the humanities-socio science, which is limited to the cognitive construction and to which evaluating construction is sometimes added, is expanded including instructive construction or rather having it as the core. I called this an expansion of "ontological constructionism" that encompasses from "epistemological constructionism", which is limited to a single mode of cognition and is established theory, to "ontological constructionism", that includes all the three modes: instruction, cognition and evaluation. *The so-called antinomy between essentialism and constructionism in the humanities-socio science turns to the ontological differentiation of generation-ism and constructionism, and, more in details, it turns out to be the trichotomy of the nomological generation of material layer, the signal programmatic generation of the biological layer, and the signal programmatic generation of the human layer.* This ontological constructionism is just a self-organization, from a different point of view, by the system and with the system's environment. However, here again the dogmatic self-organizational character of socio-science is just a ready-made concept of the nomological non-signal informatics' self-organizational character original to material science, and is nomological. Furthermore, it is completely different from the signal informatics' self-organizational character, original to socio-science, and is decentralized/centralized and participa-

tive/entrusting using the program. The self-organization by the program, which should be decisively separated from the one by the principles, has the dual problems of: 1) self-organization of the system by the program (primary self-organizational character), and 2) the self-organization of the program itself (secondary self-organizational character). As stated in the complex adaptive system by the Santa Fe Research Institute, The adoption of the program is none other than the description of secondary self-organizational character. *However, the concept of primary/secondary self-organization has absolutely no relationship with the principle non-semiology self-organization theory.* In fact, the self-organization character of bioscience includes both the principle self-organization and the programmatic one. The self-organization theory supported in the social science still hasn't resolved the two problems of: 1) the lack of a framework for the self-organization by the program rather than by the principle, and because of this, failure of the distinction between primary and secondary self-organization, and 2) the recognition that only the autonomous distributed decentralized-self-organization is the self-organization. I'm adding this to avoid misunderstanding, that in the chaos of computer simulation, chaos equations are input as the computer program, but those equations may not always be the program in the sense of programming self-organization. The chaos equations can either be the chaos principle or the chaos program. It's because the computer program processes the two big eutaxy principles in the modern science of "laws and program" as "computer

programming" equally. It is similar to the fact that both the laws and programs are available for mathematization. The point is whether or not it is the eutaxy principle that is composed of the symbol string that is inherent in the research subject itself.

Thus the core of the second subject is the "explanation of social eutaxy by the program" and the focus of the third subject that follows is the "explanation of the program itself". As for the question on the existence of the "principle" that explains "program" itself, the conclusion is negative. The explanation of the genetic program is, reflects the majority view point, that of the so-called framework of "variation and selection" by Darwin. This *"variation and selection" is also used in the explanation of the symbolic program as the framework of Pan Darwinism. But for that purpose, the variation is not limited to random variation, but includes borrowing, imitation, emergence and planned creation, and the selection comes to include advance exogenous selection (advance suppression by power, etc.), and advance/post subjective selection (endogenous selection)*. Originally, the concept of so called "natural selection" was conceived from "artificial selection"; included in the subjective selection, according to the first chapter of "Origin of Species", so in this sense, it is the so called atavismus. And the selection standard is not limited to the exogenous, maximization of comprehensive fitness by W. D. Hamilton, and *is expanded to the various endogenous criterion of value; purpose rationality, value rationality, emotion fitness, etc. by M. Weber, for example.*

After all the above, *"supertemporal socioinformatics" is another name for "socio-*

*science that claims symbolic and ontological constructionism" or the "socio-science that has the self-organizational character of the symbolic program" and can be said to be the socio-science version of the supertemporal biological informatics.* As a result, various socio-sciences, such as the study of law, sociology, economics, political science, pedagogy, business administration, social psychology, etc., can have the possibility of synthesis upon the common and general foundation of supertemporal socioinformatics. Once Marxism was said to provide the common foundation for socio-science, but today this common foundation should be found in supertemporal socioinformatics in the exact same way as biological informatics is now regarded as the common foundation of the various biological sciences.

Furthermore, I'll refer to one point in both sign information and sign information transformation. On the one hand, the understanding of sign information tends to be limited to cognitive ones, but on the other hand, evaluation information, especially instruction information and sign information transformation tends to be limited to spatio-transformation; that is, communication. But the transformation from cognitive information/evaluating information to instructive information, that is *decision making*, has a decisive meaning as the sign information phenomenon for both ontological constructionism and programming self-organizational character. *The understanding of information in the common sense biased to the two aspects of "recognition and transmittance" distorts the academic sign information understanding without*

*consciousness*. Sign information as academic jargon includes other than "recognition information" (news and knowledge, etc.), evaluation information (opinion and concept of values, etc.), and "instruction information" (intention, order, ethics and law, etc.). Sign information transformation as academic jargon includes all of the following. They are other than the communication as "spatio-transformation" of sign information transformation, memory and storage as "time transformation", duplication and copying as "media transformation", the transformation from the audio language to the written language and the reverse as "sign formation", translation, association as "meaning transformation", calculation and deduction, information emergence, decision making and "signalizing transformation"; the transformation from non-signal information = non-signal difference/pattern, such as the function of the acceptor and the sensor, to signal information = signal difference/pattern, and the "objectivization transformation"; the transformation from signal information = signal difference/pattern, such as the function of the effector and the actuator, to the non-signal information = non-signal difference/pattern. All the process/dynamic aspects in the personal/social, psychological, semantic and mental world are recognized as signal /symbolic sign information transformation.

Socioinformatics that should be temporally constrained By the way, as with all the socio-sciences, socioinformatics that should bind them must respond to the requirements of the society and era. To that purpose, firstly, I would like to describe the three basic

characters of modern society from the framework of socioinformatics. The first one is the viewpoint of sign evolution theory. The sign evolution theory has the two aspects of "evolution of the sign configuration" and the "evolution of the sign material (sign media)", *sign information/sign information transformation/program specific to the modern society is extremely rational/effective "binary electronic information space" that has "binary form" and "electronic media" as the two big characters. The mutual transformation between the various linguistic information space and the binary electronic information space in the existent human layer based on the "music/literature" form and "audio/written language" form* is the revolution of information space original only to modern society. It would have another turning point by the practical application of quantum computing.

The second is *the technical possibility of this binary electronic information space* and here I'd like to point out four points: 1) the real time character, 2) virtual character, 3) robotic (automatic machine) character, 4) global character. The robotic character is the attributes of human beings from the viewpoint of human mechanistic theory and when the global character is interpreted as the macrocosmic character (in the global human system and the cranial nerve system, in this case), those four characters are already realized in cranial nerve information space. But they are constructed outside of the individual human. Information technology, that includes the computer, internet and broadcasting/communication satellites, *instrumentalizes and institutionalizes the*

above said technical possibility of the binary electronic information space based on the various social/individual demands and human value standards: safety/ease, freedom, human rights, reliability, justice, privacy, democratic character, equality, service character, effectiveness, service character, etc. The final destination should be termed *the binary electronic information layer as the new global historic landmark* following the material/biological/human layer, rather than the human history landmark, in the same way as the highly-sophisticated information society is in contrast to the industrial society. It is such an innovative *sign informatics' evolution*. Here again, I can point out the significance of the consideration which expands the universe of discourse to the whole of nature. Just as the human layer is a part of the biology layer in a strict sense, the binary electronic information layer is a part of the human layer, and each has an isolated difference from the latter respectively. Also technological innovation in modern material space, such as nanotechnologies and drug discoveries, doesn't exist if there isn't the emergence of sign information space that precedes it, but the binary electronic character for sign information space has a decisive significance. The computer simulation would be it's one of the examples easier to understand. If there would be a periodization following the history of human beings in the history of the Earth, it must be sought in sign information space and not in material space. Either the landmark is in the history of human beings or the Earth, there's no doubt that *the binary electronic space information = binary electronic information layer, that "construct outside of*

*the individual human being" the real time character, virtual character, robotic character, global character, etc., is the biggest target that is the time-constrained socio-informatics*. The binary digitization of sign information space covers all aspects, such as the economy, politics, education and life. *The DNA program as the eutaxy principle is the original in the history of program evolution, but the binary electronic program is the latest programming pattern since the beginning of life in the history of the Earth* and its wide and deep influence is beyond prophecy.

In the third place, traditional science, or "cognition science", has the rule of the "science for science's" sake as its basis, but the movement of the gravity center from autonomous and empirical technology to planned scientific technology that arose in the 20th century increased the value of "science for society" by the end of the century, and has demanded a new scientific mode of *"design science" that includes both engineering in science and normal science in philosophies*. The binary electronic information layer is now in the midst of the device's/system's construction, so the temporal-constrained socio-informatics must strengthen its character of "design science". It means that socio-informatics is expected to step into practical *designing*, surpassing the existing and simple *cognition or the criticism* of the status quo. For the cognition/evaluation construction by the researchers, the ontological (instruction/cognition/evaluation) construction in the field must be learnt.

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In addition, regarding my "New Scientific Theory" which has a close relationship with Socioinformatics, refer to the 30 references of my writings in the list at the end of "The Paradigm Shift of Modern Science: A Tentative Assumption". The Trend of Science, Volume 8, Issue 10, The Science Council of Japan (2005) And additional writings of mine are "The Second Scientific Revolution in Capital Letters: Informatic Turn". Keynote Report for the First International Congress of IFSR (International Federation for Systems Research) (2005)



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# The Net Media and the Public Sphere

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## 0.Preface

Now "publicness" is questioned again.

It isn't extraneous to the development of the new media technology. As the "public" communication arena, the concept of "publicness", which used to be regarded as self-explanatory, is shifting.

But "media" is a fairly multisense word. It can be used to refer to the system of the symbol such as letters, iconography and audio, and is also used to indicate the carrier of symbol, such as stones, paper and radio waves. And, also it is common to categorize the <media> by the range of access, such as the personal media, local media or the mass media. In short, "media" is a general name for the various tools that actually configure our communication.

The most primitive media are our bodies themselves. And all through our long history, human beings have engaged in the development of new artificial media, from the time of oral culture to the manuscript document and then to the development of printing technology to the electric media, and further to the electronic communication

network. McLuhan called the desire for the media the "theory of the expansion of human beings".

Expanded individual <bodies> interact (communicate) with other expanded <bodies> as well, and as a total of these, our <society> is realized. In this sense, media is an expansion of the bodies, and at the same time, it is the <environment> in which that expansion is <realized>. And we can say our <society> is the realization of the total of those mutual influences at any given time.

In this paper, from those points of view, consideration is given to the fundamental issues that should be resolved, in order to consider the problems of communication space, that uses today's media as its intermediary, and the publicness.

## 1.The acceptance of the mediated public sphere and the media intermediation

### 1.1The media and the public sphere

The most well-known argument on the relationship between the media and the public sphere is by Habermas. Habermas defines the public sphere as "the social area where the

citizens as the political actors make their statements, discuss and form the public opinion via the communication method such as the mass media, based on the fundamental principle of democracy, to give influence to the policy decision and its process of implementation". <Note: Translation and may differ from the original> (Habermas, 1962, 1990) And he argues that after this type of public sphere became the foundation for the formation of civil society at the beginning of the modern period, it gradually lost its role.

The argument by Habermas has had a big influence, but it also has points to be criticized. One of them is that Habermas made a description that directly connects printed mass media with the civil publicness. The printed mass media surely provided the base information for the conversation (discussion) by the people at cafes or bars in the beginning of the modern period, but the concrete conversations were made as face-to-face communication by the people present. And a lot of the time, probably numerously made, the face-to-face communications, could have been reflected in the discussion of the printed mass media.

If that's correct, shouldn't consideration on the <public sphere>, that is related to the formation of the civil society in the beginning of modern eperiod, be found in the dynamism of correlation between the different media space of printed media and face-to-face communication? It is difficult to discuss it without considering this kind of dynamism in the multi media environment like today. We can say this problem in the argument by Habermas of course reflects the time he was living in. We might be able to think his

assumptions, that the mass media based on the print media should give the maximum influence to our organization of the <public sphere>, was recognized as self-explanatory in his eyes in 1960 <sup>1)</sup>.

## 1.2 The media space is not a solitary island

### The viewpoint of media intermediation

The communication or the information distribution in reality doesn't conclude as the connection between the certain points. It always develops, by relating and interacting with the surrounding information or the communication, and interacts. Information is this kind of infinite form and easily crosses every border like the ameba, spreads and gathers together on every media. In that sense, we cannot give consideration to one certain media space definitely separating it from the other. Whether intended or not, every media space makes multiple media environment, with other linked media spaces, unable to be separated.

And questioning how the correlation amongst different media each other is accomplished and how it is changes under the multiple media environment is the "media intermediation". (2001, Endo)

For example, looking at the process by which the internet pervaded, first the mass media and the Net media were regarded to have belonged to different spheres. The mass media observed the Net media as another field, externalizing it for good or ill. But as the Net media has become generalized, the mass media has started to see the Net media as a competition. And more recently, it seems the mass media is trying to introduce the information distributed via the Net media.

As a result, we see more and more often that public opinion or fashion starts in the net media and when it has expanded to a certain degree, the mass media picks it up. And as the synergetic effect of these, it appears as a phenomenon that is recognized as socially apparent. If we remove this character from our consideration, it's impossible to understand the <public sphere> of the modern media.

### 1.3 <Public sphere> is not a single dimensional space but Multilayered public sphericules

Similarly, the "public sphere" Habermas assumes is unitary in the whole society. But in reality, various "spheres", that have their own theory and dynamics, exist in one society. T. Gitlin insists that the concept of the "public sphere" should be formulated again as the loose connection of segmentalized "public sphericules".

Actually, we cannot say all people are living in the same <public> space. Furthermore, we express our opinion but also select the <place> of our discussion by assuming the <public> space, according to no individual standpoint or value judgment. In addition, we (especially in the modern period) belong to our multilayered social sub-system. As a result, whether we recognize it or not and whether it's anonymous or not, we belong to small multilayered <public> spaces in multiple.

The small multilayered <public> space is also related to the media where it's opened. Hence, the connection of the small public spheres is almost equal to the media intermediation.

To what extent does the argument Habermas researches on the printed media at

the beginning of the modern period shows the <total> picture, or in other words, how many people of the <total> were joined to this kind of discussion? Wasn't the discussion limited to one class of people who has influence? Here, the naivety of the argument, that the <public sphere> is a one body to cover the whole society, is exposed.

Of course, Habermas suggests various kinds of <communication sphere> and states they are interpenetrating and doesn't recognize the whole world as one <communication sphere>. But the problem is that his realistic analysis of the "interpenetrating character" is not necessarily enough. Here's the reason why it is necessary to discuss the so-called "viewpoint of media intermediation".

### 1.4 Communicative action as the sequence of the dis-communication

Another problem is Habermas' concept of the "communicative action". He formulates again the framework of the criticizing theory ("Communication is distorted by the system") which is a departure from the "pure communication model" under the "idealistic speech condition". The communicative action that Habermas discusses is mutual action trying to have influence (the speech agency behavior) over others without mentioning commonly held assumptions among the parties, acceptance orienting interaction excluding speech agency behavior, and there four adequacies are demanded of all the participants in the conversation; they are "Understanding possibility demand" (The speech is meaningful syntactically and semantically, so the participants in the conversation can understand it.), "Veridicality

demand" (The proposition content of the speech is true), "Vindication demand" (The speech is made under acceptable conditions and by acceptable people.) and "Sincerity demand" (The speaker believes in the speech content sincerely).

But looking back at our actual conversations, do they displaying as such ideal communication behavior? Even if the communication behavior is distorted by the system, basically there's no expectation that the actual conversation exchanged corresponds to the model of such pure communication behavior. (Thompson, 1995)

### 1.5 Connecting stability and transformation

Contrary to Habermas, a social scientist in the same period, Luhman, discusses the problem of the double contingency of communication. The double contingency suggests that "although the communication process connects the partners, both of the partners make their selection independently. Further, each get to know it from the other party with each exchange. That is, it refers to "the condition that has dual contingency of the selection" by the parties themselves." (pp. 11) This kind of recognition framework by Luhman is in direct contradiction with the Habermas' philosophy, that is, the pure communication behavior progresses to somewhat, so to say, the different (agreement) point. But the double contingency increases the uncertainty, so with only alone society (communication) can't be formed, and the conversation only drifts away. To tether this drift is the institution, the system and the social concept that both parties had before, which are the "generalized communication

media" according to the terminology of Luhman.

Ultimately, the opposition between Habermas and Luhman is the difference in the assumption of the logic and neither of them can solely explain the reality. Furthermore, even if we combine these we still cannot finish the jigsaw puzzle.

In the argument by Habermas, the future vision is assumed to aim at the common ideal independently composed in the intersubjective way from the discussion among the subjective individuals, the question made now is whether the "common ideal" like that ever exists. On the one hand the argument by Luhman assumes the coming condition of the social system is decided independently by the process of the communication, but it states nothing about whether it leads to the desirable future. Consequently, both of them cannot present an appropriate argument on the future. In order to find the pieces lacking, we need to observe the actual progress of the reality.

## 2. The network <public sphere> and the formation of public opinion

### 2.1 The present condition of the network <public sphere>

At the present time, there is no doubt that the media making the most notable progress is the computer network, which is represented by the internet (hereinafter called the Net). From its creation, there has been the expectation that this new media will represent the "new community" or the "new public sphere". The "virtual community theory" by H. Reingold expresses this kind of expectations

very well. Actually among the administrators or the participants of the early stage grass-root BBS, USENET or WELL, this kind of consciousness was clearly seen. Also in Japan, Notably during the opportunity of the Great Hanshin Earthquake, the expectation rose that the network could be the place for new form of civil activities that wasn't often found in the past Japan. (Refer to Endo, 1996, 2000) The argument by Hoshikawa and others represents such a position. But even if the network can be the place for the civil activities, the civil activities cannot be concluded in the network. And further, not only do the civil activities exist on the Network but there are big differences amongst the civil activities. That is, the <sphere> that the "civil activity" refers to doesn't cover the whole society and they can only be the open public sphericules.

There is an argument that makes the communication on the Network rather <anti> public existence. It is the accusation that the frequent occurrence of inflammatory or aggressive statements makes places the network in opposition to the "ideal speech condition". Ikeda (1997) indicates, based on research results of the BBS and the electronic conference room, that members there do not always feel a "sense of fellowship" to other members, suggesting they are not places that can be called "community", but are just for "chat and leave".

Contrary to that, Endou (2000) argued that the <place> for communication opened up by the Network is not the one to remind us of the strong connection as a "community" based on the viewpoint stated earlier, but is rather for the purpose of gathering, as Goffman says, and like the public square; people who gather

there, assemble and breakup and are always fluctuating. But it doesn't mean the place doesn't have a sense of publicness, like the cafes and bars in the past like Habermas argued, so it can be recognized as a <small> public sphere. This kind of small public sphere is also connected with others and open to others because of its liquidity and the multiple belonging of the each individual today.

## 2.2 When the internet resonates with the <public opinion>

There are certainly many examples of the internet acting as the engine to form public opinion, leaving behind the quite fundamental question of what is the public opinion.

In the USA, the condemnation by those internet users influenced the decision making by the big companies or the nation in the problems of the Lotus Marketplace<sup>2)</sup> or the Clipper chip<sup>3)</sup>. Also in Asia, the internet is recognized to have played a big role in the expulsion movement of the President Estrada of the Philippines, the unseating campaign and the Presidential Election in 2002 in Korea.

In Japan, the Toshiba incident created sensation. Resulting in a rare case of the company making an apology implicating a specific employee.

This has become apparent trend in all areas as the internet penetrates more deeply.

The utilization of the internet in Presidential elections in the States has taken hold since the 2000 and 2004 elections in which all kind of information was transmitted on the basis of the internet.

And in the massive anti-Japanese movement in China and Korea, the Net served

as a vehicle for agitation and rumor, as well as a means of organizing demonstration activities.

### 2.3 Is the communication via the Net the soil for the aggregation phenomenon?

The calls for warning about this kind of internet movement is also high, criticizing the movement as an hysteric aggregation phenomenon.

Also in the Toshiba incident, criticizing the whistle-blower as the "claimer" and claiming that this kind of situation "endangers the order" also gained support.

Another case is the incident in which the Minister of Foreign Affairs Machiko Tanaka, was ousted in January 2002, engendering criticism against the Koizumi administration (in the following development, the tone changed, though). But the mass media didn't pick up this development at all and an article in the Yomiuri Shimbun dated 10th February made the case that "the interactivity and the speed of e politics is one of the major breakthroughs of technical innovation, but there's always the possibility that the chain of short term reactions makes us lose the healthy directionality of democracy"<sup>4</sup>.

This kind of claim was made against the anti-Japanese movement in 2005 for sure. One of the Chinese students whom the author interviewed expressed the feeling that "the Anti-Japanese movement is just a kind of "festival" for the students who are becoming anomie. And the Net has become the perfect media to stage that kind of "festival".

### 2.4 The complexed media environment and <public opinion> formation

But with the careful observation of the cases above, we cannot say they were formed only by the "internet".

For example, the cases in the Philippines and Korea above have the rise of the democratization movement covering the whole society in the background and it was thought the campaign linked with the mass media (especially the newspapers) among the movement on the Net made a big difference.

Also in the Toshiba incident, there originally were numerous sites on the Net accusing the position of the companies and the site in question was one of them. The site was closely looked at as a big social problem because the newspapers, TVs and the magazines picked up issues that had appeared on the Net first.

That is, we should understand that the mutual reference, in the way such problems got widely known by the media picking up the movement on the Net and giving feedback to the Net and the word of mouth communication and, further to, the mass media, in the complexed media environment, makes the public opinion<sup>5</sup>.

Especially in the anti-Japanese movement in the spring of 2005, the mass media, the internet media and the face-to-face communication inside China, interacted synergistically or destructively, carrying messages from the various subjects aimed at the different intentional or non-intentional assembly action. In addition, it didn't stay in China but constituted one part of the global movement via the global communication media.

It is necessary that precise analysis be made regarding this kind of confusing and

complicated dynamic state.

## 2.5 The new form of assembly action that has the Net as its media

On the other hand, recent collective action in the <real world> is increasing. Examples are "Muneo house"<sup>6)</sup> in 2002, "matrix off"<sup>7)</sup> in 2003 and the "origami bird movement"<sup>8)</sup>. These which take place in the real world using the "seeds (neta)" created on the Net as the medium are also called "neta off"<sup>9)</sup>. The big feature of "neta off" is that it shows strong avoidance of a "political nature" trying to present itself as "nonsense performance".

Also abroad, nonsense assembly performance using the net as media became appealing since the end of 1990s. They are called e-mail mob, flash mob and so on, and are recognized as art rather than expressions of the political will of individuals aiming at assembly action. But we cannot say they're definitely separated from politics.

Rheingold indicates in "Smart Mobs"<sup>10)</sup> that the mobile network, which is more common than mobile phones, would make it possible for people to align more freely and organically than before and open up the possibility of a new form of civil movement and political actions. Nevertheless, it hasn't necessary become the <public opinion> that drove the world in the 1960s, although there surely were notable movements on the Net at the time of the Iraq war in 2003.

Rather, in the worldwide poverty fighting campaign that started in 2005, Bono, from the popular band of U2, took a leading part as liaison for the many NGOs and made a success in the fund-raising in the quite understandable form that is the sales of the

white band<sup>11)</sup>.

We can say the site of We're Not Afraid<sup>12)</sup> is a typical one that shows nature of today's <public opinion>, which was launched in a several hours, at the time of London simultaneous explosion incident which occurred on 7th July, 2005. This site appealed to the people who sympathize with the quite simple message of "We do not lose our reason by the fear of terror" and asked to send the images expressing this message. The number of such images sent from all over the world, responding to this message, reached over 10 thousand per month<sup>13)</sup>.

One thing common to these examples is that they are movements based on the appeal of a quite simplified message = individual behavior, appearing to sub-cultural sensibility. We can say it is not "discussion" in the Habermas sense, nor the simple "festival" of mass action following the crowd, but a form of "discussion" of some kind.

## 3. In conclusion, some views for the future

In this paper, we reviewed some of the movements regarding the internet's power in the formation of public opinion. But in order to discuss these issues systematically, there still remain some important problems that haven't yet been discussed enough. This paper points out some of the issues briefly.

First of all, as stated above, the activity of the modern social statement is formed in the multiple media environment. So there is the necessity to recognize the community on the internet actively and to integrate the Net more dynamically as the dynamics into the multiple media environment. And the second point is

the problem of reviewing the conditional concept of "public opinion", "public sphere" and "publicness". These concepts are connected with the "modern period as the obviousness" excessively, so we need to consider again what reality or actuality they have. We need to rebuild the new model on the dynamism of the social system.

### Notes

- 1) Habermas actually mentioned by himself this limitation in the revision of 1990 version Structural Transformation of the Public Spheres.
- 2) In 1990, Lotus Company announced that it was publishing the information database for 120 million customers. Due to strong opposition and the opposition movement by Net users who were concerned with the violation of privacy, the release of this commodity was aborted.
- 3) The Clinton administration proposed the standard of the code language named "Clipper" as a security measure. The net users opposed saying it was a surveillance policy on individuals by the government and the bill didn't pass.
- 4) Refer to Endo, October 2005.
- 5) Refer to The information Space as the Environment : The Theory and Design of the Social Communication Process, written and edited by Kaoru Endo, Agune-Shoufu-Sha, 2002.
- 6) Refer to Endo, 2003.
- 7) The group of people who are in costumes of the movie "Matrix" recreate one of the scenes from the movie on the streets.
- 8) The movement calling for people to fold origami birds remembering the atomic bomb victims in Hiroshima because many were burnt in 2003.
- 9) They are called this way because they are the development of the Off Meeting (The meeting in which people who got to know each other on the

net, meet in reality).

- 10) Rheingold, H., Smart Mobs : The Next Social Revolution, 2002
- 11) The U.S. site; <http://www.one.org/>  
French site; <http://www.2005pludexcuse.org/>  
Japanese site; <http://hottokenai.jp/>
- 12) <http://www.werenotafraid.com/>
- 13) Because the server capacity is not sufficient, the transmissions often are regulated. Therefore, it was estimated that more than two times the number of images didn't arrive even though it was intended they be sent.

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# Cyberspace as Socio-psychological Space: Cross-Cultural Comparison among the Japanese, Koreans and Finns <sup>(1)</sup>

## Keywords:

Plurality of information societies, cross-cultural research, cyberspace as socio-psychological space, information society studies, comparison among Japan, Korea and Finland

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## Abstract

Even though IT is the same as technology, substantial socio-cultural differences exist in the way IT is interwoven into socio-cultural practices and socio-psychological configuration. This article has two objectives. For one thing, I would like to make a critical scrutiny of the way information society is conceptualized and argued. Four problems associated with the conceptualization of information society are articulated and discussed. That is (1) its historical contextualization, (2) its "disruptiveness", (3) its uniformity hypothesis, and (4) its discursive structure of rosy expectations and gloomy apprehensions. I contend that these problems stem from the lack of in depth empirical studies among information society studies which pay sufficient attention to social and cultural diversity and people's practice. Therefore, I would like to do a comparative study of internet use in Japan, Finland and Korea, based on the so-called JFK survey study, so that I can decipher substantial differences across different societies in terms of the kind of IT equipment and service that is diffused, how it is used, socio-psychological attitudes toward cyberspace and so on, which is the other objective of this article. Putting them together, I propose that "information society" be taken not in its singular form, but in its plural form, "information societies" and that we advance cross-cultural research in information society studies and develop a conceptual framework to analyze and describe comparative differences of different information societies.

## 1. Growing interest in "IT" and "information society"

I would like to use the term "IT" to designate the conversion of digital, networking and mobile technologies in the 1990s and 2000s and extensive and successive technological innovations and synergistic effects associated with such a conversion. Specifically, it refers to technological innovations with internet and mobile technologies as their nucleus.

It is widely recognized that "IT" and its social diffusion has been changing the way people, things, capital and information connect with each other (e.g., Urry 2000, 2003; Castells 2000, 2003). Especially, the digital network space, cyberspace that IT creates has those characteristics which are inherently different from those of the world of space and time in which conventional socio-cultural, industrial-economic and political-administrative practices are conducted.

For instance, in Japanese society, the expansion of "*Den-en*" (social tie formed through electronic communications such as online communities and mobile communications) reduces the cost of the formation of interpersonal relations drastically and develops so-called "Smart Mobs" (Rheingold 2002), "*Beru-tomo*" or "*Meru-tomo*" (friends who do not know each other well but make frequent communications through beeper or SMS) and even the collective suicide of those who get to know each other through the internet.

Therefore, with the diffusion of the internet and mobile communications, growing attention is being paid to the concept of

"information society" and "the network society" not only in engineering and business field but also in various branches of social sciences.

## 2 Problems with the concept "Information Society" and significance of cross-cultural research

Having got interested in such a vast array of social changes, I have been working on the theoretical and empirical study of social diffusion of IT and its relationship with society and culture since mid-1990s. During this involvement, I have come up with several problematics associated with the conceptualization of "information society" "network society" and their development of discussion. I would like to point out the following four problems here.

### 2.1 Historical context of "information society"

First of all, I would like to raise the issue of how we could put "information society" in historical context. As terms like "IT revolution" and "the information revolution" suggest, much of the discourse of information society puts emphasis on "innovation" and "disruption" of IT and information society, especially in the discourse of business administration, economics and social systems engineering. Such discourse suggests, either explicitly or implicitly, the fundamental differences between information society and modern or industrialized society, strongly associated with the concept of "post-industrial society." For example, an Internet year is often compared to a dog year (one seventh of a human year). Some discussion in economics have talked about the emergence of "the New Economy,"

which was said to be different from older economic systems in that it would realize a continuous productivity growth owing to incessant technological innovations.

However, as "IT revolution" progresses, the historical recognition of information society as the social system which breaks away from older systems is getting doubtful. For instance, even though the U.S. economy enjoyed "digital economy," the IT bubble burst in April, 2000. Arguments for the new economy were diminishing.

Besides, when it comes to the speed of technological innovations, the pace of IT innovations is not so distinctively fast compared to that of the innovations in technologies such as automobiles, electricity and railways, which are major driving forces to develop industrial society. Actually, the fast pace of technological innovations is the essential characteristic of industrial society. Once social demands turn out to be evident for a certain technological breakthrough, innovations are accelerated and a wide range of applications are pursued. For instance, the Wright brothers succeeded in becoming the first to fly in December, 1903. It took no more than ten years until the airplane flew around as a military weapon in World War I. The penetration rate of black and white television sets in Japan was only 10% in 1958; it exceeded 80% just four years later, in 1962 (See also the discussion of GPT, general purpose technologies, e.g., David 1990, Helpman ed. 1998, Gordon 1999, Bresnahan and Trajtenberg 1995).

Therefore, it would be too easy a technology determinism to assert that "information society" would be a different

social system in itself. As Frank Webster asserted in his influential work, "Theories of the Information Society," (Webster 2002), it is necessary to pay much attention to the continuity of various elements such as capitalism, nation states and transnational corporations, which modern industrial society is composed of when we investigate the nature of IT and its social implications. We must develop a conceptual framework to explore the relationship between IT and society without resorting to the discourse of "discontinuity" or "disruption."

## 2.2 Discontinuity from existing social space

The first problem with the notion of information society is concerned with the focus on "discontinuity" or "disruptive innovations" in terms of diachrony or historical development. Then, the second problem is caused by distinguishing "cyberspace" as "discontinuous space" from existing social space in terms of synchrony. For example, John Perry Barlow, a founder of EFF, Electronic Frontier Foundation, and an influential figure in the internet community, put up "A Declaration of the Independence of Cyberspace" in February, 1996. He asserts:

"Governments of the Industrial World, ... , I come from Cyberspace, the new home of Mind. On behalf of the future, I ask you of the past to leave us alone. ... You have no sovereignty where we gather.

...

Cyberspace does not lie within your borders. Do not think that you can build it, as though it were a public construction project. You cannot. It is an act of nature and it grows itself through our collective actions.

... We are forming our own Social Contract . This governance will arise according to the conditions of our world, not yours. Our world is different."

We see "cyber libertarianism" as a genuine form in this declaration, which shows enthusiasm for the Internet and cyberspace in the year 1996.

As I pointed out earlier, cyberspace has some characteristics that are different from our conventional physical time and space. However, it does not mean that cyberspace is discontinuous from existing social activity space. Obviously, cyberspace cannot appear from nothing nor can it be an autonomous entity only with electronic signals over the physical structure composed of optical fibers, servers and computers.

The dynamics of cyberspace exists only through a myriad of activities of people with different intentions inhabiting existing social space. In this sense, cyberspace cannot be discontinuous from conventional socio-historical activity space both in terms of diachrony and synchrony.

For example, in the field of social psychology, Kraut et al. (1998) suggested "Internet Paradox" and raised controversies. They argued that even though the internet use for communications would be expected to have positive effects, their survey sample showed reliable negative effects of using the internet on measures of social involvement and psychological well-being. Their report draw much attention; however, it turned out that such a phenomenon appeared only at the early stage of the internet diffusion.

The paper is based on research conducted in 1995 and 1996. They did a 3-year follow-up

of the original sample; the result is that negative effects dissipated over the total period (Krauts et. al. 2002). Moreover, their new experiment suggests overall positive effects of using the Internet on communication, social involvement, and well-being. That is to say that a "rich get richer" model seems appropriate. Those who are highly sociable and have existing social support will get more social benefit from using the Internet.

At the early stage of the internet and mobile diffusion, their difference with older media looked striking and remarkable. However, as a technology diffuses, society tames it and adaptation both on the part of society and technology takes place. Thus, just as Resnick and Margolis (Resnick 1997, Margolis and Resnick 2000) point to the "normalization of cyberspace," cyberspace has fused with conventional daily social activity space. Those differences which we saw as striking at the beginning are getting familiar. In this respect also, we must constantly develop a conceptual framework to investigate the way our life-world is reorganized while the adaptation process both on the part of society and technology is under way, without resorting to the discourse of "discontinuity" or "disruption."

### 2.3 Uniformity hypothesis of "information society"

I would like to call the third problem "the Uniformity hypothesis" of "information society." When we talk about "information society" "IT revolution" and "network society," we unconsciously assume that the same kind of information society develops as far as major

industrialize countries are concerned, due to the universal and global nature of ICT. We usually take little consideration of qualitative differences among industrialized societies in terms of the development of information society. However, we have found terms substantial differences across different societies of the kind of IT equipment and service that is diffused, how it is used, socio-psychological attitudes toward cyberspace and so on. That is, "information society" should be taken not in its singular form, but in its plural form, "information societies."

In fact, Castells and Himanen claim that "the information society can exist, and indeed does exist, in a plurality of social and cultural models" (Castells and Himanen 2004:2; see also Castells ed. 2005). Then, we need a conceptual framework to analyze and describe comparative differences of different information societies.

#### 2.4 Isomorphism of technology determinism and critical arguments

The last problem I would like to point out here is a certain characteristic of the discourse concerning "information society" and "knowledge society." Many arguments regarding "information society" and "knowledge society" point to the realization of many values with the advent of information society. Curiously enough, the values mentioned have been constant, even though those ICTs which make the values realized are changing from one to another.

Such concepts as "information society" and "informatization of society" are far from being recent ones. They have been discussed since the late 1960s. It has been claimed that the

very term and concept of information society was coined in Japan (Ito 1980, 1990, Morris-Suzuki 1988:3, Tabata 2004, Castell 2000). Of course, in 1962, Machlup published *The Production and Distribution of Knowledge* in the United States, which Cawkell argues should be credited as the origin of the concept of information society. Duff (2000) discusses thoroughly the case for American provenance and that for Japanese. It is of little use here to reach any decisive conclusion of which is first. I would like to make it clear that we have a rather long history of discussion of information society in Japanese society.

Japanese scholars, Tadao Umezao, an anthropologist (1963), Yujiro Hayashi, a social engineer and futurologist (1969), Yoneji Masuda, a futurologist (1968), Kenichi Kouyama, a sociologist (1968) and others set forth such terms as *Jo-ho Sangyo*, information industry, *Jo-ho-ka*, informatization, *Jo-ho Shakai*, information society, and *Jo-ho-ka Shakai*, informatized society and developed these concepts. They raised such concepts while they tried hard to grasp and formulate the nature of the change of modern society.

Since then, "the advent of (advanced) information society" has been declared repeatedly in Japan with the wave of innovative technologies in ICT, such as videotext, fifth-generation computer, multimedia personal computer, high definition TV, PC communication, the internet, i-mode (mobile internet), ubiquitous network, RFID, and so on. We can easily remember catchy words like "new-media society", "multimedia society", "network society", "mobile society", "ubiquitous society" in Japan.

What is interesting here is that even though

the advanced technology changes from one time to another, the concept and the values "the advent of (advanced) information society" claims is almost constant at any time.

On the one hand, there have been a range of rosy expectations like "fulfillment of the desire for self-realization," "citizen-centered participatory or deliberate democracy," "diversity of value," "flexible customization for individual needs," "exhibition of creativity" and so forth, with the advent of information society. They are rather of naive technology determinism.

On the other hand, we have seen many arguments that put emphasis on the dark side of information society. Some warn of the advent of a surveillance society following George Orwell's work "1984" (1949). Others point out the violation of privacy, abuse of personal information, "disintermediation" due to direct transactions between business and consumer, elevation of power of multinational corporations controlling the flow of information, increase of unemployment due to the advancement of automation, and the like.

Curiously enough again, both rosy pictures and dark-side pictures share the same argument structure. Technology determinism picks up a certain characteristic of leading-edge technology at the time which has something to do with any of the rosy pictures of the future; then, based on such a characteristic, they argue that the development of such a technology leads to a rosy future of society. On the other hand, critical arguments take up a characteristic of leading-edge technology at the time which has something to do with any of the dark-side pictures that suggests structural problems of

contemporary world; then, based on such a characteristic, they argue that the development of such a technology leads to and/or reinforces dark and uncertain future of society.

Such an argument structure above has much to do with the "duality" inherent in ICT. The duality is that while ICT is considered to be the cause, or driving force, behind social change and problems, at the same time, ICT is thought to be the cure or answer to the changes and problems (which ICT itself is alleged to cause). Owing to this rather peculiar duality, ICT draws much attention and allures us into the argument structure of naive technology determinism or critical argument.

## 2.5 Necessity of cross-cultural research

I believe that the four problems discussed so far stem from the lack of empirical studies in the research of information society which pay sufficient or profound enough attention to social and cultural diversity and people's practice.

Interest in the concept of information society lies in our recognition or premonition of the diversified and extensive changes of society. However, each discipline tends to focus on very narrow and specialized topics; on the other hand, discourse to try to grasp such aggregative social change is inclined to fall into the argument structure of naive technology determinism or critical argument.

Therefore, what we need now is a comprehensive and aggregative analysis of high granularity based on diversified empirical studies. In this respect, we could expect cross-cultural research to make substantial contribution to the study of information

society.

Of course, it is easy to say so; it is very hard to do so, in actual fact. I cannot claim that I have a well-formulated methodology and theoretical framework to conduct such an endeavor of cross-cultural research on cyberspace. In the next section, I would like to present my own struggle and challenge in the comparative study of Japan, Korea and Finland in the use of IT.

### 3 Cyberspace as socio-psychological space and its socio-cultural differences

Needless to say, Korea, Finland and Japan all are the societies which could be called pioneering and advanced information societies along with the United States. Before the main discussion, let me take a brief look at the diffusion of advanced information and communications technologies in each society.

Finland is one of the Northern European countries and holds the world's largest cellular phone company, NOKIA. Northern Europe is a leading area of IT development and achieves the highest ratio of diffusion of the Internet and cellular phones in the world, which is almost the same in actual volume as the U.S. (Castells and Himanen 2004, Kimura 2004).

As for Japan and Korea, the commercialization and social diffusion of FTTx (Fiber to the home, curb, building etc.) and advanced mobile technologies. As of September 2006, the number of FTTH subscribers in Japan was 7.15 million, and in Korea almost 3 million people living in high-rise apartments subscribed to FTTB, fiber to the building, or FTTC, fiber to the curb, coupled with high-

speed LAN connection. They are by far ahead of Europe and the United States. Both societies are also leading in the spread of 3G mobile services. According to ENTER, a Spanish research agency, and IDATE, an European consulting firm, as of June 2006, the number of 3G customers is estimated to be just over 100 million. The Asia-Pacific region accounts for 50%, or 54 million, of which 29 million are in Japan and 11 million in Korea.

Therefore, it is of great significance to compare these three societies from a cross-cultural point of view when information society studies are undertaken.

I have been involved in research on social diffusion of IT and the relationship between IT and society and culture since 1994. During the course of research, I have had a chance to conduct research activities not only in Japan but also in Korea and Finland, deploying various methodologies, such as questionnaire surveys, focus group interviewing, household hearing, diary survey, and so on. For example, in Japan, I have been engaged in national questionnaires with the sample size of 2000 to 3000 almost every year since 1997.

In the course of these various research activities, I have been struck with the socio-cultural differences among three countries. What has struck me most, and worried me most, about the way IT is used in Japan is the strong socio-psychological attitude of avoidance or even denial toward cyberspace (see Kimura 2004).

In Japan, the internet and cyberspace is dominated by, and conceived as, "anonymity"; socio-psychological attitudes toward cyberspace among the Japanese are very negative (Figure 1). People tend to avoid being

involved in social communication over the internet, which leads to little network activity. So, the social network in the real world and that in the cyberspace are separated.

Our study shows a particular characteristic of Japanese young people's usage of

cyberspace networks. In cyberspace, they tend to keep social relationships among strangers (we can call it "anonymous tie"), and they seldom assume they will meet face-to-face, which is obvious in comparison with Korean youth (Saito & Kimura 2005). This

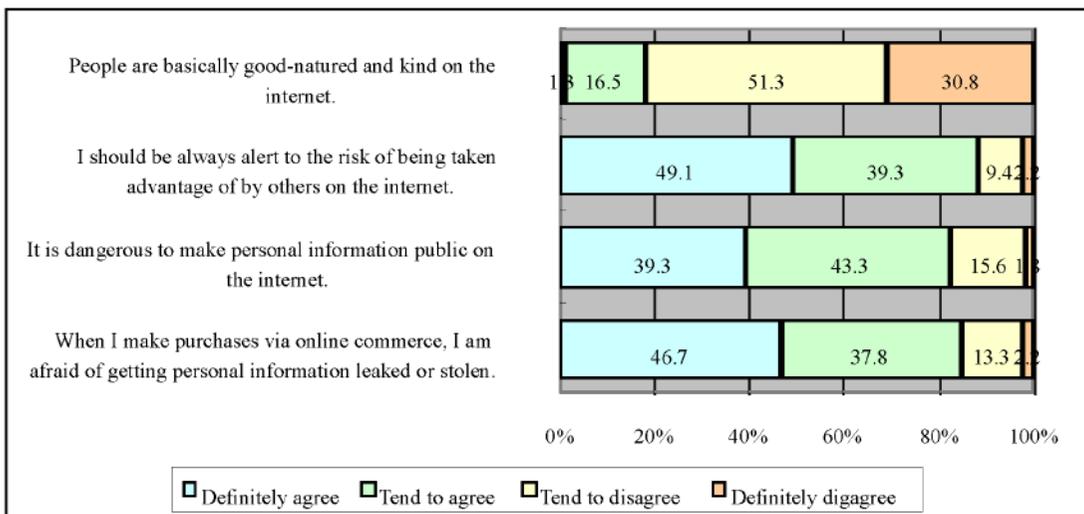


Figure 1 Negative attitudes toward cyberspace among Japanese university students (Self-administered questionnaire, distributed and collected in class, Waseda University, on June 2006; the sample is 223).

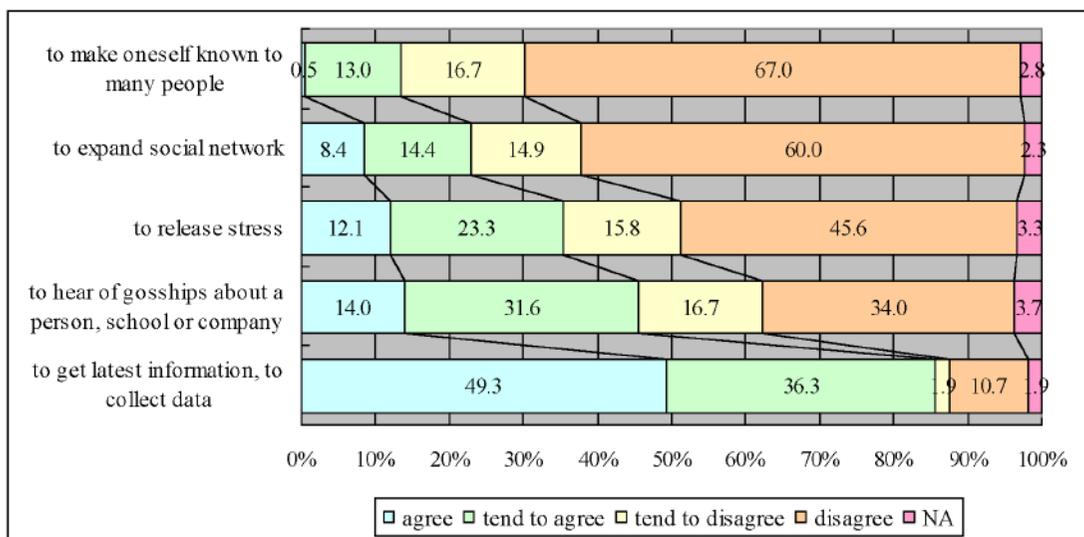


Figure 2 efficacy or purpose of BBS use (national questionnaire survey in December, 2003, the sample is 1878 persons from 12 to 69 years old living in Japan)

tendency is regarded negatively by other generations (especially the middle-aged or older) considered to be a new and strange aspect of young people's attitudes toward the society and social relationships. It is this tendency, which is often considered to be relevant to the development and diffusion of

the Internet in Japan.

Take a look at Figure 2 and Figure3. Based on the questionnaire, five factors have been distinguished as to the efficacy or purpose of the internet use. That is, 1) to collect information, to gather data, 2) to hear of gossip, 3) to release stress, 4) to make oneself

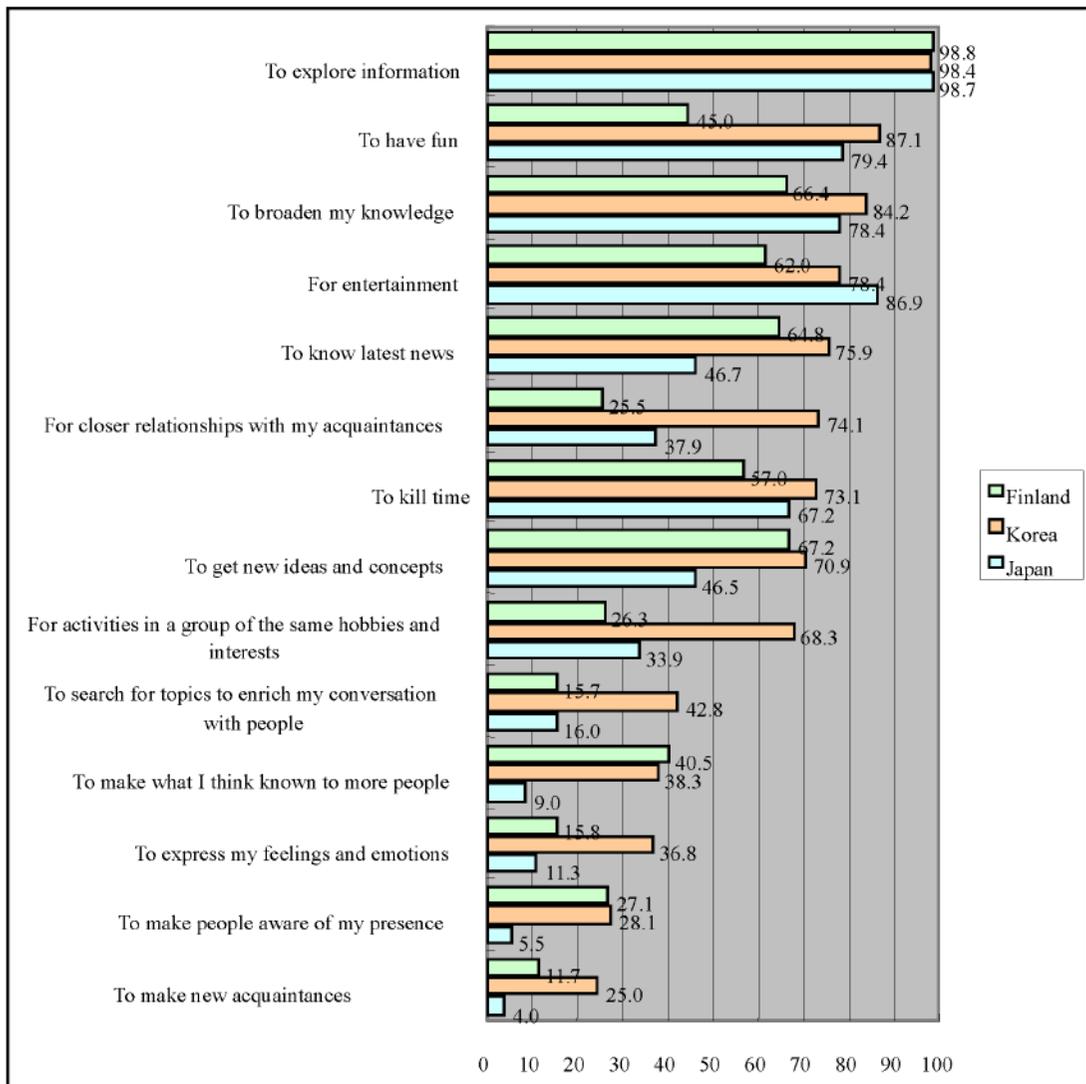


Figure 3 efficacy or purpose of internet use (Japan-Finland-Korea, comparative college student questionnaire survey. JFK survey study: in Tokyo in December 2002, the sample is 487 students at Waseda University; in Helsinki in October 2003, 315 students at Helsinki University; in Seoul in December 2002, 490 students at Korea University)

known to others, to express oneself, 5) to widen one's social network. The first factor, collecting information, is by far the highest in every society.

However, compared with other societies, the Japanese refer to the fourth and the fifth factors the least frequently. Cyberspace as an anonymous space functions as a place to take a peek at and to shout abuse to release stress; it does not function as a place to make and expand social networks and to get to know each other, in a word, it does not function as a means of communications.

By contrast, Korean people involved in

cyberspace use their real names. Social network in the real world and that in cyberspace overlap and reinforce one another. Cyberspace functions as a means of communications and social activity. As is widely known, the killer application of Korean internet use is "community sites." Community sites such as "daum" (www.daum.net) and "cyworld" (www.cyworld.com) have more than 10 million registered users and millions of communities. People are expected to disclose themselves and use their real names (see also Kim 2004).

The socio-psychological differences in

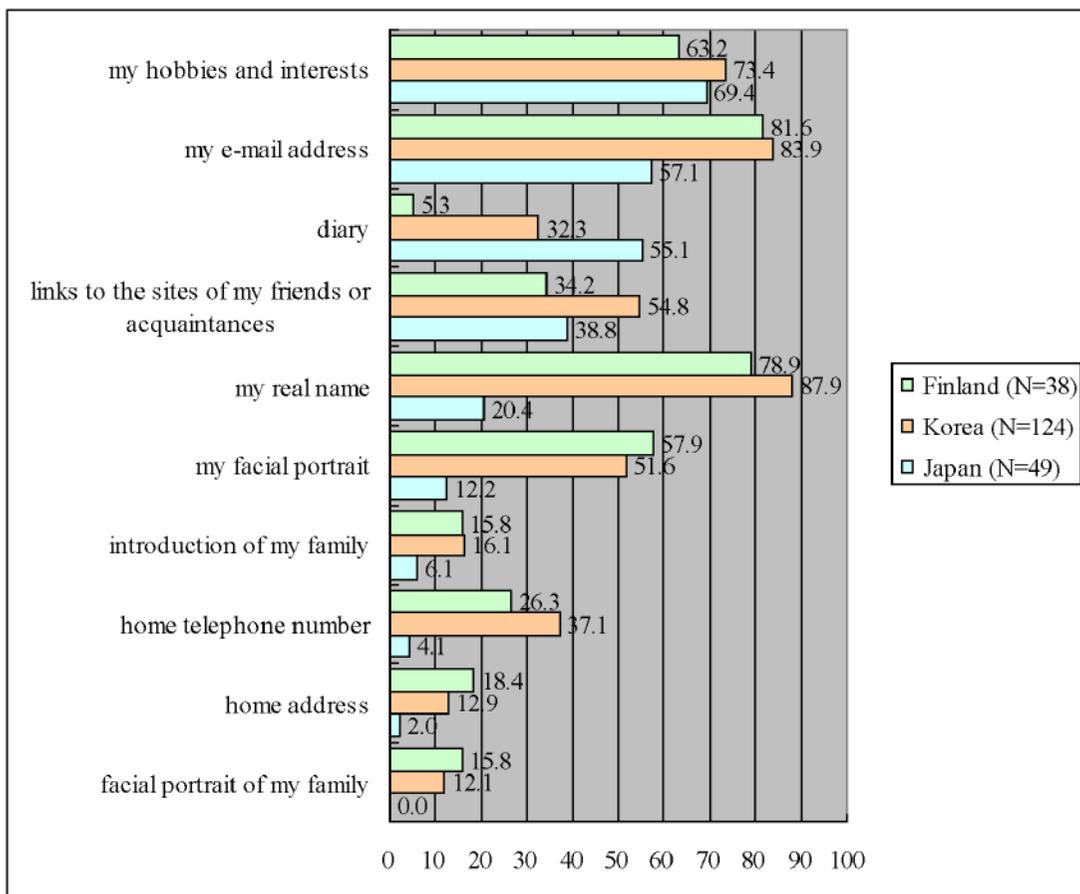


Figure 4 self-disclosure on the homepage (JFK survey)

attitude toward cyberspace mentioned above also clearly appear in the data of self-disclosure on the homepage. Figure 4 shows a part of the results of JFK survey study. We asked those students who had their own homepage what kind of information they had on their homepage. First of all, the percentage of those students is 25.3% in Korea, 10.1% in Japan and 13.3% in Finland. Certainly, Korea is outstanding in this respect.

When we turn to the extent of self-disclosure, that of Japanese students is strikingly low. They do not put their real name, e-mail address, facial portrait, telephone number or their family. More than half of Korean students who have a homepage have some links to homepages of their friends or acquaintances, which seems to suggest Korean use their the internet as a means of expanding and reinforcing social network. On the other hand, Finnish students have the fewest links to homepages of their friends or acquaintances. Taking other data into consideration, to Finnish students, cyberspace functions mostly as a means of making oneself known to others.

In addition, concerning factors possibly determining whether people possess personal homepages or not, we can point to a similar phenomenon. According to our survey results of Japan, Finland and Korea, we found socio-cultural differences among the societies (Saito & Kimura 2005). Japanese young people seem to need exclusively private space at home, to possess and manage their homepages, although Finnish and Korean young people do not necessarily care about the places and they seem to create and manage in public places such as libraries and universities.

Moreover, Japanese youth appear to be motivated to possess their homepages for very private reasons. Those having homepages tend to be more interested in healing themselves on the Internet than others. This may reflect the Japanese youth's tendency of emphasize private purposes (web diaries indicated below) rather than academic or business purposes.

One of the striking characteristics about Japanese students is that the number of those who write their diary on the web exceeds half of all homepage holders. This rather peculiar phenomenon has something to do with the socio-psychological configuration of interpersonal relations through out the various media among the Japanese. Japanese under 40 years old use the text messages of mobile phones as a default means to make interpersonal communication with their friends. They avoid voice communications. Voice communications are for lovers or partners; even with close friends the psychological distance made by voice communications feels too close to keep. So, many young Japanese send a text message to ask friends whether they could make a voice phone call before they actually do so.

If we suppose text messages of mobile phones become a default means to engage in inter-personal communication with their friends, even with close friends, how can they carry out interpersonal communication with rather distant friends or acquaintances? Web diary seems to function as a means of such a distant communication. That is, people record daily happenings and everyday affairs on their web diary. Their friends and acquaintances sometimes get access to them. Then, when

they meet each other, they have something shared to talk about. The Japanese as a communication subject are getting "encapsulated" equipped with digital media. The Web diary is the means to maintain interpersonal relationships with psychologically more distant friends and acquaintances rather than mobile text messages.

I am afraid that such a strong socio-psychological attitude of avoidance or even denial toward cyberspace among the Japanese

may have much to do with characteristics in our real world. Take a look at Figure 5. We can find a significant difference in interpersonal trust among the three societies. Japanese college students are the least positive toward propositions like "Most people trust one another" and "Most people are basically good-natured and kind." I am growing afraid that lack of interpersonal trust in the real world could prompt the development of cyberspace as socio-psychological anonymous space.

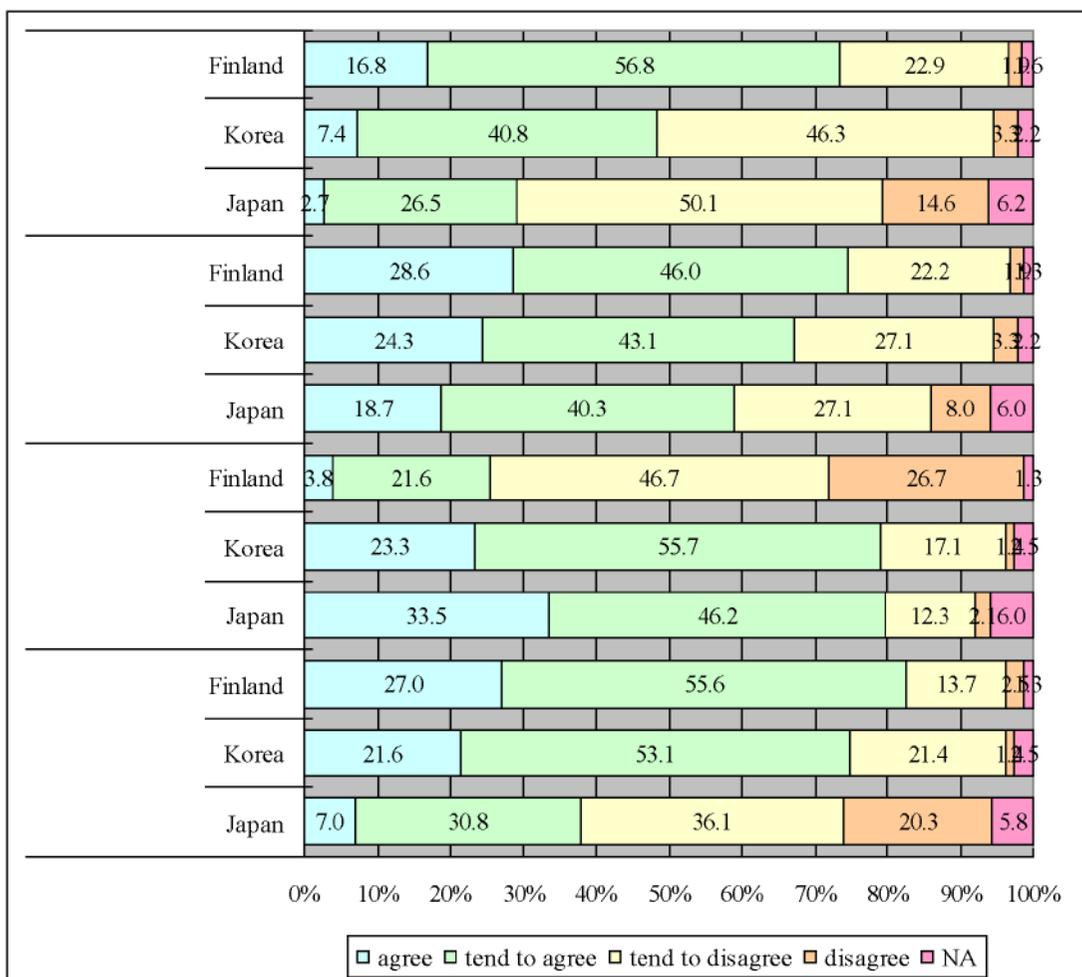


Figure 5 interpersonal trust (JFK survey)

This socio-psychological characteristic of Japanese society, may give us something about the elementary stage of Japanese society experience in facing the development and diffusion of cyberspace about a decade or so ago (Saito & Kimura 2004). People might then recognize the negative aspects of cyberspace, since many crimes and suicides that could be considered to come from somewhat abnormal ties on cyberspace. Then, people found that cyberspace had a dangerous potential as well as positive function more strongly than Finnish and Korean people, who seem to be more aware of strengths and benefits of cyberspace.

As I discuss in this section, even though IT is the same as technology, we find substantial socio-cultural differences in the way IT is interwoven into socio-cultural praxis and socio-psychological configuration. I hope researchers of different societies exchange ideas much more intensely and more effort to investigating and describing the plurality of information societies in fruitful detail.

#### Notes

(1) This article is based on the paper Kimura wrote and presented in English at International conference on "The Use of Information Technology in the Research and Education in Social Sciences" held at the Institute for Cross-Cultural Studies, Seoul National University on November 21st, 2005. The conference paper was revised with Yoshitaka Saito and translated into Finnish by Teppo Turkki, Director of Institute for Art, Development and Education Art Universities of Finland and published as an article in the book, Katja Valaskivi ed. "Vaurauden Lapset: Näkökulmia japanilaiseen ja suomalaiseen

nykykulttuuriin." (Children of Affluence. Approaches to Japanese and Finnish Contemporary Culture) in November 2006. This article is another revised version of the conference paper.

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# FtF and Mobile email Personal Networks and Loneliness: Focusing on the Interaction Effects of Sociability and Personal Networks

## Keywords:

Loneliness, Personal Network, Sociability, Mobile email, Face-to-Face (FtF) Communication

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## Abstract

This research has two purposes. The first purpose is to investigate the relationships between loneliness and the sizes of the personal networks in face-to-face (FtF) communication and in communication via mobile email (including email and short message services). The second purpose is to examine interaction effects on loneliness that exist between sociability and the size of FtF and mobile email personal networks. This paper discusses these points, based on the Japanese social survey by Hashimoto and his co-researchers in 2003. As seen in the results of regression analysis, the relationship between the size of mobile email personal networks and loneliness was weaker than between the size of FtF personal networks and loneliness. However, for the higher sociability group, there was a significant relationship between the size of FtF personal networks and loneliness, but not for the lower sociability group. On the other hand, for the lower sociability group, the size of mobile email personal networks showed a significant relationship to loneliness, but not for the higher sociability group. These findings indicate the interaction effects of sociability and personal networks on loneliness.

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## 1. Introduction

### 1.1. Mobile email and Loneliness

The number of mobile phone contracts reached 81,520,000 at the end of March, 2004 (FY2004 WHITE PAPER Information and Communications in Japan). If one contract per person is supposed, more than 60% of Japanese owned a mobile phone. According to the survey for personal use rate of mobile phones (including car telephones and PHS), 84.4% of 15-59 year-old Japanese use a mobile phone (NRI, 2003).

Current mobile telephones are treated as "personal digital assistant" with various functions even though we call them "mobile phones". In interpersonal communication, the text-message communication function becomes as important a function of the mobile phone as the call function. According to a survey by Video Research Ltd. (2002), 75.2% of mobile phone users use mobile email. More than 90% of mobile phone users of 12-29 years old use mobile email (Video Research Ltd., 2002).

Miyake (2001) found that a characteristic amongst university students is that mobile email is used for communication not only with friends they meet often but also with friends they rarely meet. She states that mobile email is the interpersonal communication media which is used very willingly for communication. According to a survey on university students by Tanaka (2001), 76.5% of respondents chose from specific options that "The spread of mobile email has made communication more convenient" and 60.7% of them chose the option of "Personal relationships have changed due to the spread

of mobile email."

We can say that a mobile phone, with its phone and email functions, is an important medium in personal relationships in Japanese modern society.

In the studies on interpersonal communication, many researchers have been interested in Computer-Mediated Communication (CMC) since the 1980s (e.g. Kiesler et al., 1984; Garramone et al., 1986). According to Miyata (1993), in CMC, the absence of face-to-face communication, individuality, non-verbal clues, and the liberation of distal and time limitation are notable characteristics.

Mobile email communication is an example of CMC and perhaps the CMC most widely practiced in Japan. In mobile email communication, synchronousness is considerably more guaranteed compared with email communication on the PC (Hashimoto, 2001).

A problem related to the use of CMC that is often cited, is the problem of mental well-being.

Kraut et al. (1998) researched the influence of Internet use on loneliness and depression. They gave computers with an Internet connection to people in Pittsburgh, Pennsylvania and tracked their Internet use and mental well-being over a period of two years. The results showed that greater use of the Internet was associated with statistically significant declines in social involvement, and increases in loneliness and depression. Their results drew a large amount of scrutiny and criticism (Joinson, 2003).

Also on the subject of mental well-being, the use of mobile email is often discussed with reference to the problem of loneliness. For example, Fujitake et al. (2001) suggested if

even one email does not reach its destination, the result can be uneasiness at not connecting with other people. Kawaura (2002) stated that the use of mobile email could expose the reality of personal relationships and possibly increase loneliness.

Loneliness is an important concept in the consideration of well-being. Loneliness is often discussed, not only with regards to modern society in general, but also in connection with the development of information and communication technologies (ICTs). This present study will deal with the relationship between mobile email use and loneliness, focusing mainly on a discussion of the relation between the size of mobile email personal networks and loneliness.

## 1.2. Loneliness and Personal Network

According to Peplau & Perlman (1979), loneliness is defined as the undesirable and subjective experience occurring from the discrepancy between achieved and desired levels of social contact. There has been a lot of research on the relationship between loneliness and personal networks. Many studies researching this relationship examine quantitative features of personal networks (e.g., the number of friends, the number of intimate friends).

To examine the validity of the revised UCLA loneliness scale, Russel et al. (1980) researched the relation between social behaviors and the scores on the scale. What they considered to be grounds for validity was significant negative correlation between the scores in the scale and the number of intimate friends. To examine the validity of the revised UCLA loneliness scale in Japanese, Kudo and

Nishikawa (1983) used the fact that the people who had higher scores on the scale had fewer friends than people with lower scores. Jones et al. (1985) and Levin & Stokes (1986) showed a significant negative correlation between the size of one's personal network and loneliness.

Research, however, has also been done on the relationship between the size of FtF personal networks and loneliness. Igarashi (2002) examined the relationship between the size of personal networks via CMC and loneliness. From the results of two surveys; one university students and one on the Internet, he showed that when friends talk about important things via CMC, the actual number of friends has no significant effect on loneliness, just as it doesn't in FtF conversation, conversation via telephone, or letters. In the survey on the users of Massively Multiplayer Online Role Playing Game "Lineage", Shimura & Ikeda (2004) showed that there was a weak relationship between the size of Lineage personal network and loneliness.

These findings indicate that the size of one's FtF personal network can have a relationship with loneliness, but the size of one's CMC personal network does not. Or if it does, it is weak.

Although loneliness is an undesirable and subjective experience occurring from the discrepancy between achieved and desired levels of social contact, the size of personal networks is a feature of the achieved level of social contact, and is not a feature of the desired level. Additionally, there can be a difference between the desired level of FtF and one's CMC personal network.

When we consider the relationship between the size of personal networks and loneliness, we must consider the cognitive factors which produce the discrepancy between the achieved and desired levels. When we want to compare FtF and mobile email personal networks, this perspective can be effective.

### 1.3. The Desired level of Personal Network and Sociability

I consider sociability as a factor in the recognition of the discrepancy. Sociability is defined as a tendency to affiliate with others and to prefer being with others to remaining alone (Cheek & Buss, 1981 ; Buss, 1986). People who have higher sociability might regard FtF communication as important. This then will affect the desired level of social contact in one' s FtF personal network.

It is true that sociability affects not only personal networks but also loneliness itself.

Stokes(1985), and Levin & Stokes(1986) examined two theoretical models on the relationship between loneliness and personal traits: the "social network mediation" model and the cognitive bias model. The social network mediation model is a model that supposes that loneliness can be affected by personal traits mediating one's personal network, and predicts, for example, that people with nervous temperament will have difficulty making social contacts, so their personal networks will be poor and they will feel loneliness. On the other hand, the cognitive bias model predicts that people who have a negative understanding and poor opinion of other people will underestimate their personal relationships, and therefore experience greatest loneliness. The results of

analysis showed that each model showed partial validity.

According to the cognitive bias model, people who have higher sociability will have lower levels of loneliness. Sociability tends to go hand-in-hand with high levels of social skill and generalized trust. Social skill involves the verbal and non-verbal ability to build good human relationships. Some researchers show that social skill has a significant relationship with loneliness (e.g., Jones, 1982; Vaux, 1988; Igarashi, 2002), as does trust Moroi (1985).

But, when we control the relationship between loneliness and personal traits, we can form the following hypothesis: that people with higher sociability, but a small FtF personal network, may experience greater loneliness because of the greater discrepancy between their desired level of FtF personal network and their real network. The converse therefore is that there would be less loneliness with a lesser discrepancy. If, on the other hand, they have lower sociability, their desired level of FtF personal network may be lower. So, there is less or no discrepancy between their real and ideal situation. In other words, for people with lower sociability, there may be a weak relationship between the size of their FtF personal network and loneliness.

What relationship does sociability have with mobile email communication?

First, Kasagi & Daibo (2003) pointed out that people are less likely to recognize interpersonal pressure in CMC. This is true in communication via mobile emails, which use mainly text messages. Tsuzuki & Kimura (2000) analyzed the evaluation of communication media by university students, and found that there may be lower interper-

sonal pressure in mobile email communication than in other mediated communications.

From these findings, even people who have lower sociability can maintain their personal network easily using mobile email communication. Human beings are social animals and need social relationships (Buss, 1986). Although the desired level of FtF personal network amongst people with lower sociability might be lower, the desired level and expectation of mobile email personal network would be relatively higher, because of the general desire for social relationships.

It would follow them that if these people with lower sociability had a small mobile email personal network, the discrepancy between their real and ideal situation would be bigger, and their loneliness greater. On the other hand, people with higher sociability, and a greater desire for FtF communication, media-assisted communication might complement their FtF communication but the size of their mobile email personal network would have a weaker relationship with loneliness than the size of FtF personal network.

When we consider the effects of the size of FtF and mobile email personal networks on loneliness, we have to focus on sociability. It may be especially useful to examine the interaction effects of the size of FtF and mobile email personal networks, and sociability, on loneliness.

#### 1.4. The purposes of this study

The purposes of this study are as follows. To examine the relationships between the size of FtF and Mobile email personal networks and loneliness.

This study examines findings of earlier studies. The hypothesis is as follows: The size of mobile email personal networks has a weaker relationship with loneliness than the size of FtF mobile networks.

To examine the interaction effects between sociability and the size of personal networks on loneliness.

On the relationship between loneliness and personal networks, the recognition of the discrepancy between the achieved and desired levels of personal networks is crucial. This study examines the interaction effects of sociability and the size of FtF and mobile email personal networks on loneliness.

## 2. Data

### 2.1. Survey

In this study, I performed a second analysis of the data collected by a Japanese national survey conducted by Prof. Hashimoto and his co-researchers in 2003 <sup>(1)</sup>.

This poll was a panel survey following a survey conducted on Japanese males and females who were 12-69 years in November to December, 2001. One in 2001 was based on a two-stage stratified random sampling of 3000 people in Japan. Hard-copy versions were hand-delivered to respondents, and also collected by hand. Of the selected individuals, 62.6% completed the survey, providing a total sample size of 1878 respondents. The data used in this present study was collected in November to December of 2003. This survey was conducted on the respondents who completed the one in 2001. Of the selected individuals, 66.3% completed this survey, providing a total sample size of 1246

respondents.

## 2.2. Scales construction

### (1) Size of FtF personal network

The size of FtF personal networks was measured by asking respondents to imagine a maximum of ten people (network others) other than cohabiters, whom the respondents considered intimate. The number of network others whom the respondents met once or more a month (0 to 10) was used as the size of their FtF personal network.

### (2) Size of mobile email personal network

The size of mobile email network was measured by asking respondents the number of people with whom they communicated by mobile emails.

### (3) Loneliness

Loneliness was measured by revising three items from the revised UCLA loneliness scale in Japanese (Kudo & Nishikawa, 1983): "I have no friend whom I can trust", "My interests and opinions are different from those of other people in my environment," and "I get along well with people in my environment (Reversing item)." Each item was measured on a four-point scale: 1 = agree; 2 = somewhat agree; 3 = somewhat disagree; 4 = disagree. I conducted a principle component analysis and used the first principle component score as the score of loneliness (Eigenvalue: 1.35; Proportion: 0.45).

### (4) Sociability

Sociability was measured by two items: "I do not feel uncomfortable when talking with a stranger," "I often go out to social gatherings". Each item was measured on a four-point scale: 1 = agree; 2 = somewhat agree; 3 = somewhat disagree; 4 = disagree. I

standardized and summed up the two items and used the score as the score for sociability ( $r = .34, p < .001$ ).

### (5) Personal traits: Social Skill, Generalized Trust

I used social skill and generalized trust as controlling variables, because they were the personal traits expected to correlate highly with loneliness and sociability.

Social skill was measured by revising 8 items from KiSS-18 (Kikuchi, 1988): "I can continue a conversation with a stranger," "I can express my emotions frankly", etc. Most of the items were those items which Kim (2004) defined as basic to communication skill<sup>(2)</sup>. Each item was measured on a four-point scale: 1 = agree; 2 = somewhat agree; 3 = somewhat disagree; 4 = disagree. I conducted a principle component analysis on the eight items and used the first principle component score as the score for social skill (Eigenvalue: 4.07; Proportion: 0.51).

Generalized trust was measured by three items from Yamagishi's generalized trust scale (Yamagishi, 1998): "Most people are basically good and kind," "I can trust other people," "Most people trust other people". Each item was measured on a four-point scale: 1 = agree; 2 = somewhat agree; 3 = somewhat disagree; 4 = disagree. I conducted a principle component analysis on the three items and used the first principle component score as the score for generalized trust (Eigenvalue: 1.82; Proportion: 0.61).

### (6) Demographic Variables

Demographic variables were gender (dummy variable), age, marital status (dummy variable), and number of cohabiters.

### 3. Results

#### 3.1. Features of the Respondents

After dropping the respondents with missing data in the main variables, there were 586 remaining for the analysis in this study.

There were 245 males (41.8%) and 341 females (58.2%). The deviation toward females was because there were more females than males amongst the mobile mail users (51.0% of the males and 56.4% of the females used mobile email).

The Respondents' ages were as follows. 14-19 years old: 75 people (12.8%); 20-29 years old: 130 people (22.2%); 30-39 years old: 152 people (25.9%); 40-49 years old: 118 people (20.1%); 50-59 years old: 84 people (14.3%); 60-69 years old: 22 people (3.8%); and 70-71 years old: 5 people (0.9%)

As for marital status, married respondents numbered 337 (57.5%), and single respondents numbered 249 (42.5%).

The mean of the number of cohabiters was 3.97 (S.D. 1.50).

#### 3.2. The size of Personal Networks

The mean of the size of FtF personal

network was 4.44 (S.D. 3.06). The mean of the size of mobile email network was 5.12 (S.D. 4.46). The mean of the number of people with whom respondents communicated by mobile email was 2.45 (S.D. 2.62).

#### 3.3. Correlations between Variables

To confirm correlations between variables, I conducted correlation analysis. The results are shown in Table 1. All figures in table 1 are Pearson's correlation coefficients.

The correlation analysis showed that social skill, generalized trust, sociability, and size of FtF and mobile email personal networks had a significant negative relationship with loneliness ( $p < .01$ ). Social skill had the biggest correlation coefficient with loneliness ( $r = -.30, p < .01$ ), and amongst the variables with a significant relationship with loneliness, the size of mobile email personal network had the smallest correlation coefficient with loneliness ( $r = -.12, p < .01$ ).

The relationship between the size of personal networks and personal traits (social skill, generalized trust, and sociability) were as follows. Social skill and sociability had a significant positive correlation with the size of

Table 1: Correlations between variables

	1	2	3	4	5	6	7	8	9
1 Loneliness	—								
2 Gender	-0.09 *	—							
3 Age	-0.02	-0.05	—						
4 Marital status	0.15 **	-0.01	-0.66 **	—					
5 The number of cohabiters	-0.07 †	0.06	-0.17 **	-0.07 †	—				
6 Social skill	-0.30 **	0.07 †	0.09 *	-0.09 *	0.001	—			
7 Generalized trust	-0.22 **	-0.01	0.16 **	-0.10 *	-0.04	0.16 **	—		
8 Sociability	-0.20 **	0.002	0.10 **	-0.12 **	0.02	0.50 **	0.23 **	—	
9 The size of FtF personal network	-0.20 **	0.07 †	-0.03	0.03	0.09 *	0.27 **	0.08 †	0.19 **	—
The size of mobile email personal network	-0.12 **	0.07 †	-0.15 **	0.13 **	0.005	0.12 **	-0.004	0.19 **	0.20 **

†  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$  ( $N = 586$ )

FtF personal networks ( $p < .01$ ). At 10% significant level, generalized trust had significant correlation coefficient with the size of FtF personal networks. With the size of mobile email personal network, social skill and sociability had a significant positive relationship ( $p < .01$ ). But generalized trust had no significant relationship with the size of mobile email personal network ( $r = -.004, n.s.$ ).

The correlation analysis showed a positive relationship between the size of FtF and mobile email personal networks. ( $r = .20, p < .01$ ).

These results support the opinion that people communicate with close others called "strong ties", by mobile email (Hashimoto 2001; Kobayashi and Ikeda 2004).

To be exact, according to Hashimoto et al. (2002), "when respondents were asked with whom they communicated most frequently by mobile email in private, most chose the option 'others whom you see frequently'". However, when asked with whom they communicated the second most frequently by mobile email in private, they chose the option "others whom you do not see frequently". (Figure 1).

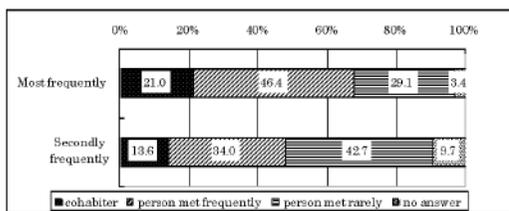


Figure 1: people with whom you communicate by mobile email (Based on Hashimoto et al., 2004)

According to the surveys on Internet usage

trends in Japan (Hashimoto and Mikami et al., 2002; 2004), about 60% of the respondents chose the option, "Friends whom you see frequently" as the person with whom they communicated by mobile emails, and about 40% said "Friends whom you do not see frequently" (Figure 2).

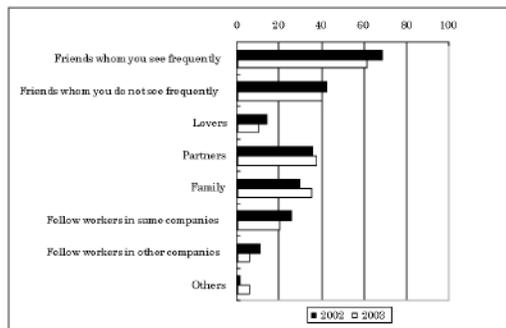


Figure 2: People with whom you communicate by mobile emails (Multi answers) (Based on Hashimoto and Mikami et al., 2002; 2004)

These findings indicate that, people frequently communicate with "strong ties" by mobile emails, but, more than a few people communicate by mobile emails with others whom they do not see frequently.

### 3.4. Examination of the Interaction Effects

I conducted regression analysis on all the respondents to examine the effect of the size of personal networks on loneliness (Table 2). The dependent variable was the score of loneliness.

In model 1, the independent variables were demographic variables and personal traits (social skill, generalized trust, and sociability). The result showed that age, marital status, social skill, and generalized trust had significant coefficient. These effects of the

demographic variables and the personal traits were consistent in all models.

In model 2, I added the size of the FtF personal network as an independent variable to model 1. The result showed that the size of the FtF personal network had a significant negative coefficient on loneliness ( $b = -.04$ ,  $\beta = -.11$ ,  $t(577) = 2.85$ ,  $p < .01$ ). This result indicates that the size of the FtF personal network has a significant relationship with loneliness, even if the demographic variables and personal traits are controlled.

In model 3, I added the size of the mobile email personal network as an independent variable to model 1. The result showed that the size of the mobile email personal network had a significant negative coefficient on loneliness ( $b = -.02$ ,  $\beta = -.09$ ,  $t(577) = 2.35$ ,  $p < .05$ ). This result indicates that the size of the mobile email personal network has a significant relationship with loneliness, even if

the demographic variables and personal traits are controlled.

In model 4, I added the size of the FtF and mobile email personal networks as independent variables to model 1. The result showed that the size of the FtF personal network had a significant negative coefficient on loneliness ( $b = -.04$ ,  $\beta = -.10$ ,  $t(576) = 2.52$ ,  $p < .05$ ), the effect of the size of the mobile email network on loneliness was a significant tendency ( $b = -.02$ ,  $\beta = -.07$ ,  $t(576) = 1.94$ ,  $p < .10$ ). These results show consistency with Igarashi's findings (2002), in which the CMC personal networks have little effect on loneliness, compared with the FtF personal network. A significant effect of the mobile email personal network shown in model 4 might include the effect of the FtF personal network with mobile email communication.

In model 5, I examined the interaction

Table 2: Regression analysis on all the respondents

Dependent variable: loneliness Independent variables	Standardized coefficients ( $\beta$ )				
	model1	model2	model3	model4	model5
Gender (male = 0 / female = 1)	-0.06 †	-0.06	-0.06	-0.05	-0.05
Age	0.17 **	0.17 **	0.15 **	0.16 **	0.16 **
Marital status (married = 0 / single = 1)	0.22 **	0.22 **	0.22 **	0.23 **	0.23 **
The number of cohabiters	-0.03	-0.02	-0.03	-0.02	-0.03
Social skill	-0.25 **	-0.23 **	-0.25 **	-0.23 **	-0.23 **
Generalized trust	-0.18 **	-0.18 **	-0.18 **	-0.18 **	-0.19 **
Sociability	-0.02	-0.01	-0.004	0.0004	-0.003
The size of FtF personal network	—	-0.11 **	—	-0.10 *	-0.09 *
The size of mobile email personal network	—	—	-0.09 *	-0.08 †	-0.10 *
Sociability * The size of FtF personal network	—	—	—	—	-0.05
Sociability * The size of mobile email personal network	—	—	—	—	0.07 †
$N$	586	586	586	586	586
$R^2$	0.16	0.17	0.16	0.17	0.18
$\Delta R^2$ from model4	—	—	—	—	0.01
$F$ value of $\Delta R^2$ from model4					$F(2,574)=3.50^*$

†  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$

effects of sociability and the size of personal networks on loneliness.

Conforming to the Cronbach method (Cronbach, 1987), I added the products of sociability grand centered and the size grand centered of FtF and mobile email personal networks as independent variables to model 4. The result showed that the interaction effect of sociability and the size of the mobile email personal network on loneliness was a significant tendency ( $p < .10$ ). The R-squared of model 5 was significantly higher than that of model 4 ( $F(2, 574) = 3.50, p < .05$ ). These results indicate that there may be interaction effects of sociability and the size of personal networks, especially of mobile email networks, on loneliness.

### 3.5. Differences by Sociability

To examine and analyze differences between respondents with higher sociability and those with lower sociability, I separated them into two groups based on the mean of the score of sociability. The lower sociability group included 241 people, and the higher

sociability group included 345 people.

To examine the effects of the sizes of FtF and mobile email personal networks on loneliness, I conducted regression analysis, with loneliness as the dependent variable for each group. These results are in Table 3.

In model 1, the independent variables are demographic variables and personal traits (social skill, generalized trust, and sociability). The result in the lower sociability group showed that social skill and generalized trust had significant coefficients on loneliness. And the result in the higher sociability group showed that besides social skill and generalized trust, also age and marital status had significant coefficients on loneliness. In all models, these results were consistent.

In model 2, to examine the effect of the size of FtF personal networks on loneliness, I added the size of FtF personal networks as an independent variable to model 1. The results showed that, in the lower sociability group, the size of FtF personal networks had no significant coefficient on loneliness ( $b = -.02, \beta = -.06, t(233) = .95, n.s.$ ), but, in the

Table 3: Regression analysis on the lower and higher sociability groups

Dependent variable: Loneliness	Standardized coefficients ( $\beta$ )							
	lower sociability group				higher sociability group			
	model1	model2	model3	model4	model1	model2	model3	model4
Gender (male = 0 / female = 1)	-0.07	-0.06	-0.05	-0.05	-0.04	-0.04	-0.04	-0.03
Age	-0.01	-0.03	-0.05	-0.06	0.26 **	0.28 **	0.26 **	0.27 **
Marital status (married = 0 / single = 1)	0.03	0.02	0.02	0.02	0.32 **	0.35 **	0.33 **	0.35 **
The number of cohabiters	-0.05	-0.05	-0.07	-0.07	-0.02	-0.002	-0.02	-0.001
Social skill	-0.20 **	-0.19 **	-0.21 **	-0.20 **	-0.30 **	-0.25 **	-0.28 **	-0.24 **
Generalized trust	-0.23 **	-0.23 **	-0.26 **	-0.26 **	-0.15 **	-0.14 **	-0.14 **	-0.13 **
The size of FtF personal network	-	-0.06	-	-0.02	-	-0.18 **	-	-0.17 **
The size of mobile email personal network	-	-	-0.16 *	-0.16 *	-	-	-0.08 †	-0.07
<i>N</i>	241	241	241	241	345	345	345	345
<i>R</i> <sup>2</sup>	0.12	0.12	0.14	0.14	0.19	0.22	0.20	0.22

†  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$

higher sociability group, it had a significant negative coefficient on loneliness ( $b = -.06$ ,  $\beta = -.18$ ,  $t(337) = 3.49$ ,  $p < .01$ ).

In model 3, to examine the effect of the sizes of mobile email personal networks on loneliness, I added the size of mobile email personal networks as an independent variable to model 1. The results showed that, in the lower sociability group, the size of mobile email personal networks had a significant negative coefficient on loneliness ( $b = -.06$ ,  $\beta = -.16$ ,  $t(233) = 2.57$ ,  $p < .05$ ), but, in the higher sociability group, the effect was significant tendency ( $b = -.02$ ,  $\beta = -.08$ ,  $t(337) = 1.68$ ,  $p < .10$ ).

Finally, in model 4, I added the size of FtF and mobile email personal networks as independent variables to model 1 to examine the effects of these on loneliness. The results showed that, in the lower sociability group, the size of FtF personal networks had no significant effect on loneliness ( $b = -.01$ ,  $\beta = -.02$ ,  $t(232) = .23$ , *n.s.*), but the size of mobile email personal networks had a significant effect on loneliness ( $b = -.05$ ,  $\beta = -.16$ ,  $t(232) = 2.39$ ,  $p < .05$ ). On the other hand, the results showed that, in the higher sociability group, the size of FtF personal networks had a significant negative effect on loneliness ( $b = -.06$ ,  $\beta = -.17$ ,  $t(336) = 3.34$ ,  $p < .01$ ), but the size of mobile email personal network had no significant effect on loneliness ( $b = -.02$ ,  $\beta = -.07$ ,  $t(336) = 1.36$ , *n.s.*).

#### 4. Discussion and Future Research

The analysis of all the respondents showed that the main effect on the size of mobile email personal networks was a significant

tendency when the size of FtF personal networks was controlled. This result is consistent with Igarashi's (2002) findings. Model 5, including the interaction effects, however, had significantly higher R-squared than model 4. This result indicates that it might be important to consider sociability as the personal trait responsible for the discrepancy between the size of personal networks and the desired level of social contact when we analyze the relationship between the size of personal networks and loneliness.

The separable analysis on the lower and higher sociability groups produced clear results.

In the lower sociability group, the size of FtF personal networks had no significant coefficient on loneliness. People who have lower sociability may have a lower desired level and expectation of FtF personal network, so there is no discrepancy between the desired and achieved levels. On the other hand, in the lower sociability group, the size of mobile email personal network had a significant negative coefficient on loneliness.

These results may be interpreted as indicating that the lower sociability group's cognition of the discrepancy between the achieved and desired levels of social contacts was influenced by the size of mobile email personal networks because they have a relatively higher desired level and expectation of mobile email personal network than of FtF personal network. Even if people have lower sociability, they avoid social isolation, because humans are social animals.

On the other hand, in the higher sociability group, the size of FtF personal networks

consistently had a significant negative coefficient on loneliness, but the size of mobile email personal networks had no significant coefficient on loneliness when the size of FtF personal networks was controlled.

People who have higher sociability would have the need to affiliate with others, so their desired level of social contacts would be higher. If they have a lower achieved level of social contacts, there would be a discrepancy between the desired and achieved levels. The achieved level of mobile email personal networks of people with higher sociability cannot reduce their cognition of the discrepancy.

There were differences between the lower and higher sociability groups in the coefficients on loneliness based on the respondents' ages and marital status. These results could be interpreted as indicating that older people with higher sociability could not engage as actively as young people in interpersonal behavior, but that they had a higher desired level of social contacts. Also people who have higher sociability would consider it important to have the stability of having others around them. So, in the higher sociability group, the respondents' marital status had a significant relationship with loneliness.

These points indicate the effectiveness of using sociability to explain the desired level and expectation of personal networks, and of considering the interaction effect of the achieved level of personal networks and sociability on loneliness.

The next thing to consider is problems connected with this study, and future issues to be explored.

In this study, the focus was on the quantitative features of personal networks. However, Cutrona (1982) and others showed that qualitative features of personal networks (satisfaction, intimacy, etc.) showed stronger correlation with loneliness than the quantitative features. While the study by Cutrona (1982) was on the relationship between FtF personal networks and loneliness, Shimura & Ikeda (2004) studied the relationship between the qualitative features of CMC personal networks and loneliness. They showed that the size of CMC personal networks had no significant effect on loneliness although the degree of satisfaction of CMC personal networks had a significant effect. These indicate that we have to examine the interactive effects of the qualitative features of personal networks and sociability on loneliness.

This study has a problem in terms of causal relationships. In this study, I conducted a one time data analysis. This study examined only the correlations, not the causal association. However, Igarashi & Yoshida (2003) and Shimura & Ikeda (2004) have examined the causal relationships between loneliness and personal networks by panel surveys. Although this study does not examine the causal relationships, based on the earlier studies, it is possible to reason that the personal network can affect loneliness. Because the earlier studies, however, had not examined the interaction effects, to examine the causal association should be a future issue for exploration.

Although this study examined the interaction effects of sociability and personal networks, there are some personal traits

which affect interpersonal behavior. Future research on loneliness must examine these personal traits closely.

Also the results in this study showed that the higher the level of sociability of people, the larger their size of personal network. As for the size of mobile email personal networks, the relationship was the same.

Sakamoto et al. (2000) indicate by their experiment the possibility of CMC as a tool for social training. They showed that shy people could increase their sociability in the real world by training in the Multi-User Dungeon. Mouri et al. (2001) pointed out, however, that the effect of such training on the shy people could not be sustained. Although there is mail counseling, which is counseling using CMC (e.g. Takaishi et al., 2002), it is also important to improve sociality in FtF communication.

And there is the problem with loneliness tolerance which was pointed out by Nakamura (2003) and Hashimoto et al. (2004). The problem is that people who use mobile email more frequently have, not only lower level of loneliness, but also lower loneliness tolerance. This can be related to the point by Kawaura (2002) that the use of interpersonal communication media might expose the reality of personal relationships.

The development of ICTs has made various communication modes possible. This causes various problems with interpersonal communication. We must continue to accumulate findings on interpersonal communication in modern society.

Lastly, this study is a second analysis, so it has certain limits. In this study, I examined my hypothesis by analyzing existing social survey data. Therefore, each concept was

manipulated by the available variables. This was a constraint that caused some problems in this experimental study.

Although there is a lot to be done in future research, the findings in this study hopefully could contribute to the theoretical exploration of this important social issue.

#### Acknowledgements

- (1) The data used in this study is by the survey supported by grants from the Japan Society for the Promotion of Science, KAKENHI13410046. The survey was conducted by Professor Yoshiaki Hashimoto, Associate professor Ken-ichi Ishii, Associate professor Tadamasu Kimura, Associate professor Daisuke Tsuji, and Assistant professor Sangmi Kim. The author would like to express his greatest thanks to them for their permission to use of data.
- (2) In this study, social skill was measured by the following eight items: "I can continue a conversation with a stranger," "I can express my emotions frankly," "I can initiate conversation with a stranger quickly," "I can express my emotions and feelings frankly," "I can introduce myself to a person I meet for the first time," "I can readily enter in a conversation others are having," "I can help others well," "I can instruct others clearly regarding what I would like them to do," "I can be reconciled with people I have argued with."

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# A Quantitative Analysis on the Impact of The Usage of Information Equipment in the Non-production Division<sup>(1)</sup>

Keywords:

Information Equipment Ration, labor productivity, Growth accounting, DEA

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## Abstract

The aims of introducing information system into business are divided largely into the two. One is to reduce unwanted cost by improving efficiency, and the other is to create new value-added. The former is the supreme proposition the business community has been always working on, and IT has greatly contributed for that purpose. However, even if unwanted cost should be reduced to zero, the business could not survive if the products or services they offer are not sold. Therefore, it is the creation of new values that is required of the business now. And its success hugely depends on how effectively the non-production division of the business can make use of information equipment.

The purpose of this paper is to carry out a quantitative analysis of the impact of IT investment at the level of industry-sector. The Information Equipment Ratio is defined as an index to show the Information and Communication-related Capital-labor ratio, and its impact on the amount of value-added per person (labor productivity) is analyzed and examined for each industry-sector by making use of methods of Growth Accounting and DEA (Data Envelopment Analysis).

The results show that the contribution of information equipment in 1990-2002 declined compared to that of the second half of 1980, and that, in 1990-2002, a significant slack is seen in the Information Equipment Ratio and in the workers with an educational level higher than college. These fact findings strongly suggest that the non-production division of the Japanese business did not make an effective use of information equipment in this period.

## 1.Introduction

Information systems are indispensable tools in business today, and the information processed through such systems is frequently counted as one of the four managerial resources along with human resources, materials, and money. Though it is not at all easy to identify the cause of the difference between thriving business entities and those in slack, it is quite clear that the cause lies in one or more of those four resources. Above all, the importance of information and information systems as its tools have been long touted.

Needless to say, the mere increase in IT investment cannot improve business, and its effective use is required by the firms in order for them to contribute to the business results. However, very little research exists which shows the effect of IT investment quantitatively and systematically. This not only hinders decision making on investment on the part of the management, but also furthers ambiguity concerning ways of IT investment.

Meanwhile, the purpose of information systems use is quite different between the production division and the non-production division, depending on the kind of business. In general, the non-production division of a given business gives priority to the earnings contribution by marketing, the decision of promotion strategy and executions, and/or efficiency improvement of clerical work, while the production division pursues efficient improvement of factory activities. It is indispensable that both use the information systems according to each one's purpose so that the enterprise may grow steadily. And,

analyzing the cause of corporate growth or decline quantitatively is quite meaningful.

In this paper, the production division / the non-production division of the enterprise are analyzed through financial indicators and Growth Accounting. Then, the hypothesis is derived and verified by using DEA.

In Section 2, financial indicators of enterprises are analyzed, and the decrease in efficiency of the non-production division is showed.

In Section 3, we analyze the relation between the capital related to IT investment and the labor productivity by making use of Growth Accounting model, and show that the contribution of IT investment to the labor productivity has decreased. And, we derive the hypothesis that the cause is in the way by which the information equipment is used in the non-production division. In addition, Section 4 verifies this hypothesis by using DEA.

In this paper, the "production division" is defined as the division in which the labor cost is included in the sales-cost, and the "non-production division" is defined as the division in which the labor cost is included in the sales-administration-cost. Then, labor productivity is defined as the amount of the value-added per employee, is defined as a sum of the cash flow (sum of labor cost, operating profit, and depreciations). A concrete method of calculation is described in Section 2 and Section 3.2.2.

## 2. Analysis of Labor Productivity by Financial Indicators

Stages of the use of IT in business can be summarized as follows; 1<sup>st</sup> stage: as a tool for

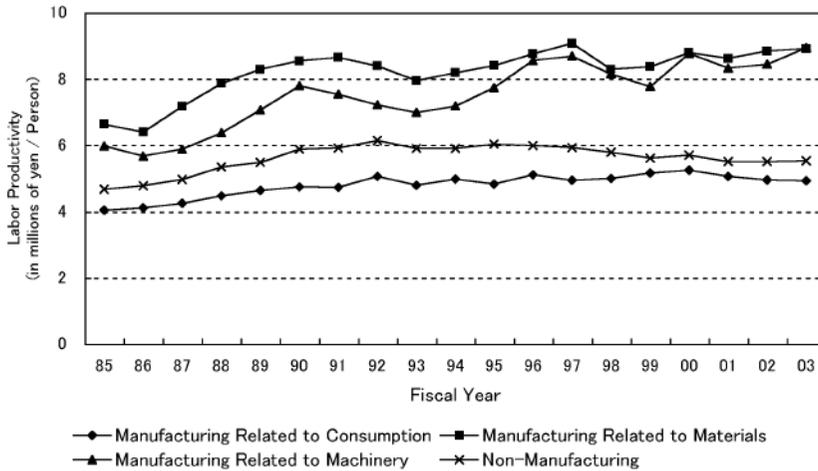


Figure 1. Change of Labor Productivity in Each Sector

raising efficiency by replacing manual labor, 2<sup>nd</sup> stage: as a tool for providing useful managerial information, 3<sup>rd</sup> stage: as a tool for realizing business strategies; and 4<sup>th</sup> stage: as a tool for innovating business process (i.e. the way the business should be) in accordance with its environment. The difficulty of its measurement, as well as the difference of their effects between the successful and the unsuccessful businesses, grows in the above order. The purposes of IT investment vary greatly, from automation and labor-reduction to the support of managerial strategies. Even though its purposes vary and its impacts cannot be determined definitely, the majority agrees on its contribution to the improvement of labor productivity, through the discussions on the productivity paradox. However, it can be pointed out that for IT to contribute to labor productivity, its mere increase is not enough, and the construction of systems for its effective use through organizational innovation, and education and training are required.

In this Section, the actual situation of labor

productivity through the relevant data is investigated, before discussing the impact of IT investment on improvement of labor productivity. Figure 1 shows the change in labor productivity between 1985 and 2003 for the manufacturing industries related to consumption, materials, and machinery, and non-manufacturing <sup>(2)</sup> calculated from the data in Financial Statements Statistics of Corporations by Industry (FSSCI). It shows changes in labor productivity of each industry-sector. Then financial indicators are used to investigate the causes of such changes in labor productivity. Labor productivity is defined as follows:

$$\text{Labor Productivity} = \frac{\text{Value-added}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Tangible Fixed Assets}} \times \frac{\text{Tangible Fixed Assets}}{\text{No. of Employees}}$$

$$= \text{Value-added Ratio} \times \text{Turnover of Tangible Fixed Assets} \times \text{Labor Equipment Ratio},$$

where

$$\text{Value-added} = \text{Operating Profit} + \text{Labor Cost} + \text{Welfare Cost} + \text{Depreciations}.$$

This shows that improvement of labor productivity requires higher Value-added

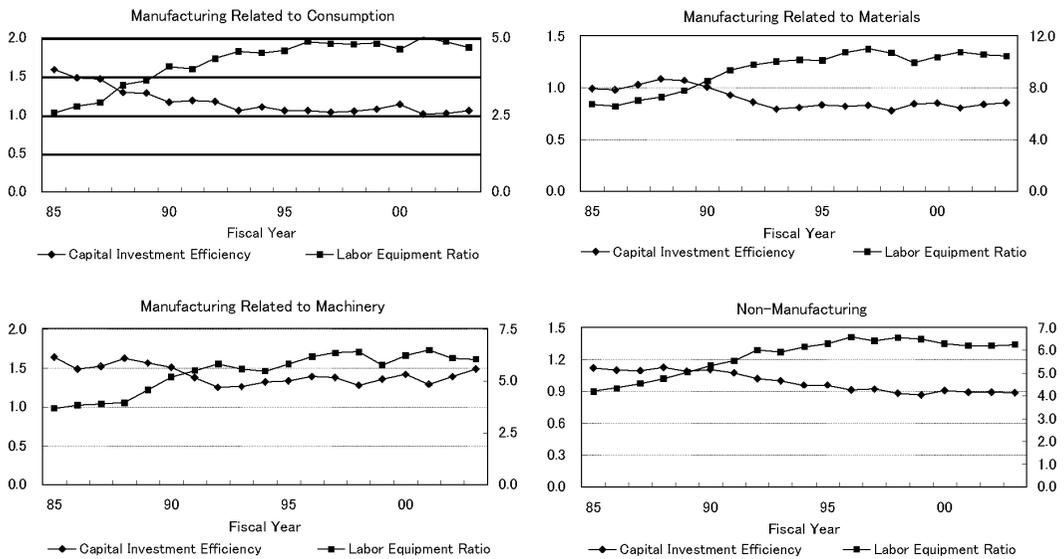
Ratio, increase in Turnover of Tangible Fixed Assets and/or improvement of Labor Equipment Ratio .

Figure 2 shows the results of breaking down Labor Productivity into the changes in Capital Investment Efficiency and in Labor Equipment Ratio, where

$$\text{Capital Investment Efficiency} = \text{Value-added Ratio} \times \text{Turnover of Tangible Fixed Assets}$$

It shows that the Labor Equipment Ratio is constantly increasing in all sectors. This

indicates that the main factor to improve labor productivity is the improvement of the Labor Equipment Ratio. Then, on which part has this increase of Labor Equipment Ratio had the most positive impact to bring about growth in labor productivity? Figure 3 shows ratios of the sales-cost and sales-administration-cost to the (total) sales during 1985 to 2003. In all sectors, the ratio of sales-cost is declining, but that of sales-administration-cost is constantly increasing. Assuming that the change in the



(Unit: yen/yen for Capital Investment Efficiency (Left Scale), in 10 million yen/person for Labor Equipment Ratio (Right Scale))

Figure 2. Change of Capital Investment Efficiency and Labor Equipment Ratio

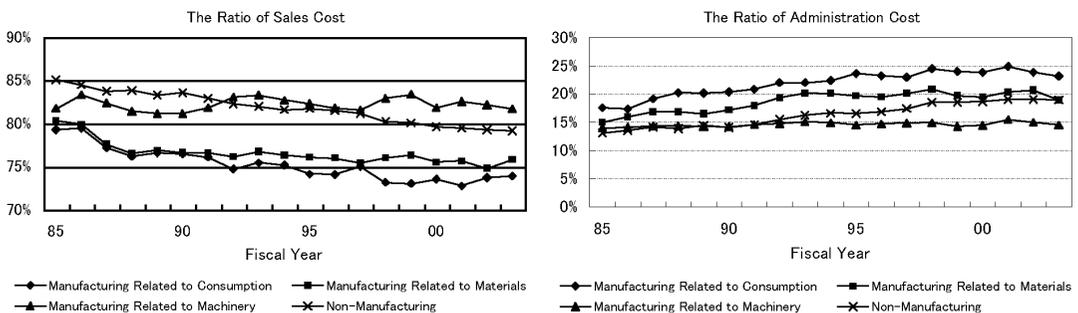


Figure 3. Change of the Ratio of Sales Cost and Administration Cost to the Sales Amount

ratio of sales-cost indicates an improvement of efficiency in the production division and that the change in the ratio of sales-administration-cost indicates improvement in the non-production division, this result shows that the improvement of Labor Equipment Ratio has contributed mainly to the efficiency improvement of the production division. It also means that it has not contributed to efficiency improvement of the non-production division, and that it merely contributed to its expansion<sup>(3)</sup>.

From the beginning of 1990s, a large amount of personal computers and other IT devices began to be deployed, and their networks started spreading in offices. However, there has been no proof of labor productivity improvement in the non-production division can be seen from the data. Certainly, the assessment based upon the above financial indicators alone is not totally acceptable, because of the complicated influence of the relative relationship between wage and prices involved in determining the level of labor productivity. Although it is true that the non-production division has expanded considerably, as suggested by the large-scale introduction of IT equipment in offices (IT investment in the non-production division), its effect on improvement of labor productivity in the non-production division is rather doubtful, considering the increase in sales-administration cost.

In the following Sections, attempts are made to give rational explanations to this fact referring to use of information equipment and labor quality classified by educational level estimated for this purpose.

### 3. Analysis of Economic Impacts of Information Equipment by Growth Accounting Model

In the previous Section, the trend of various financial indicators after the second half of 1980s and its implication were shown. It is highly possible that the stock accumulated as the result of IT investment have had an impact on these indicators. Consequently, in this Section, the influence of IT investment on the cash-flow which takes place as a result of corporate business activities is analyzed. The analysis-period is from the fiscal year 1985 to 2002, and the sectors analyzed are the manufacturing sectors related to consumption, materials and Machinery, and the non-manufacturing. In the following Sections we use FSSCI data for cash-flow.

#### 3.1 Model

Formula (3.1) shows Growth Accounting Model employed herein. In this model, the growth rate of the amount of Value-added per Employee  $q$  (hereafter referred to as Labor Productivity) is divided into its determinant factors, which are the Annual Working Hour per Employee  $h$ , the amount of Information and Communication-related Capital Stock per Employee  $k_i$  (hereafter referred to as Information Equipment Ratio), the Capital Stock other than Information and Communication-related Capital Stock per Employee  $k_o$  (hereafter referred to as Capital Equipment Ratio), and External Factors  $A$  (technological progress and so on).

$$G(q) = A + \alpha G(h) + \beta G(k_i) + \gamma G(k_o) \quad (3.1)$$

where

$G(X)$ : Annual Growth Rate of  $X$

$$\alpha = (\partial q / \partial h) / (q/h) \quad (3.2)$$

$$\beta = (\partial q / \partial k_o) / (q/k_o) \quad (3.3)$$

$$\gamma = (\partial q / \partial k_i) / (q/k_i) \quad (3.4)$$

$q$ : Labor Productivity

$h$ : Annual Working Hours per Employee

$k_o$ : Capital Equipment Ratio

$k_i$ : Information Equipment Ratio

$A$ : Constant indicating the impact of External Factors.

Assuming the homogeneity of degree 1, the following equations hold:

$$\alpha + \beta + \gamma = 1 \quad (3.5)$$

$$\alpha = wh / q = \text{Share of Labor} \quad (3.6)$$

$w$ : Wage Rate

$$\beta = r_o k_o / q = \text{Share of Capital Stock other than Information and Communication-related Capital Stock} \quad (3.7)$$

$r_o$ : Profit Rate of Capital Stock other than Information and Communication-related Capital Stock

$$\gamma = r_i k_i / q = \text{Share of Information and Communication-related Capital Stock} \quad (3.8)$$

$r_i$ : Profit Rate of Information and Communication-related Capital Stock.

However, since the calculation of  $r_o$  and  $r_i$  is very difficult, we calculate  $\alpha$  by using the equation (3.6). And assuming  $A$  is a constant,  $\gamma$  is calculated by following formula from the data<sup>(4)</sup>.

$$\gamma = \frac{\frac{\Delta q}{q} - \alpha \frac{\Delta h}{h} - (1 - \alpha) \frac{\Delta k_o}{k_o}}{\frac{\Delta k_i}{k_i} - \frac{\Delta k_o}{k_o}} \quad (3.9)$$

Finally, using these results and (3.5),  $\beta$  is calculated.

## 3.2 Data

### 3.2.1 Information Equipment Ratio

Information Equipment Ratio  $k_i$  is defined as

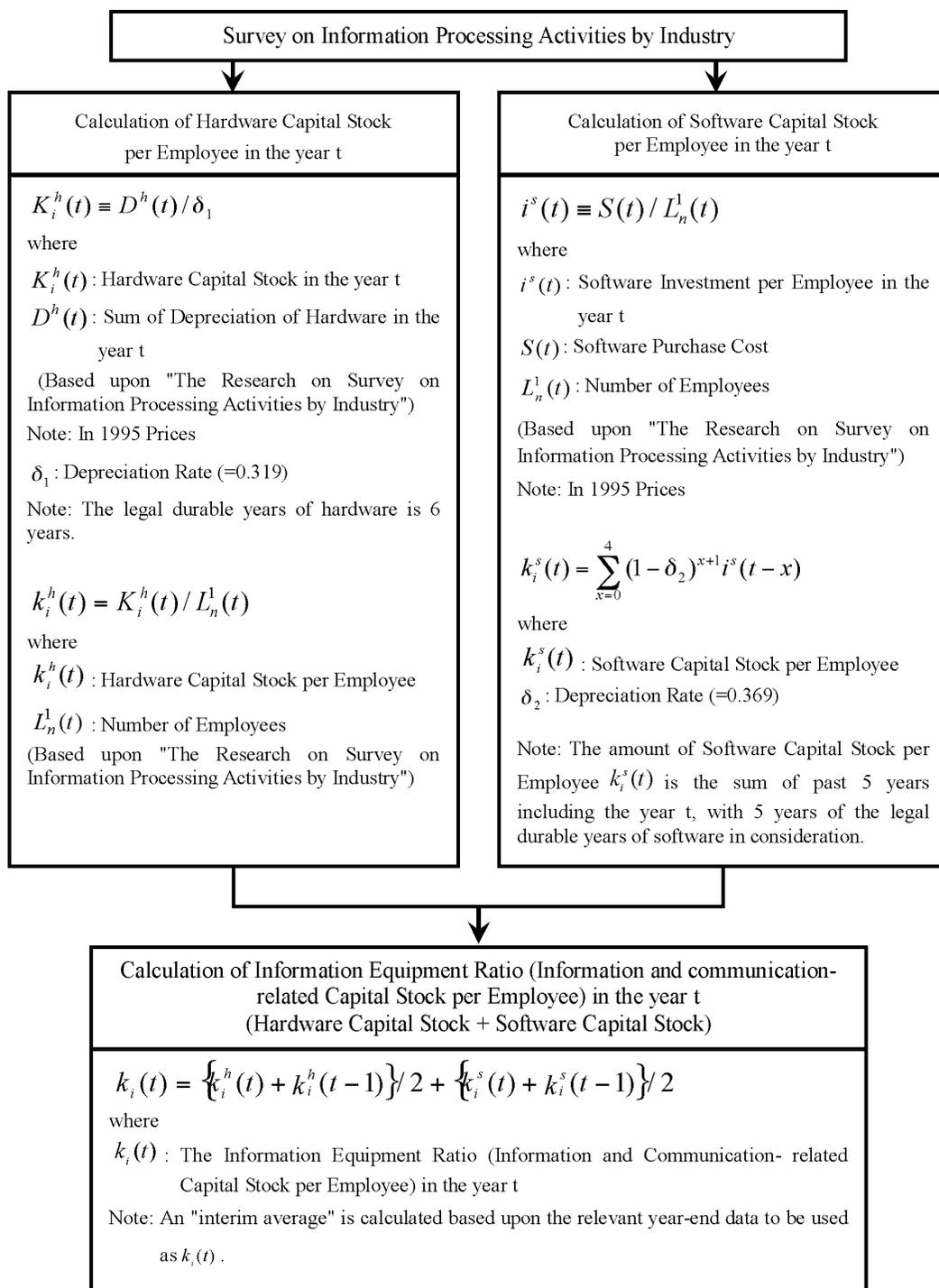
Information and Communication-related Capital Stock (hereafter referred to as Information Equipment) per Employee. In this paper, we calculated  $k_i$  from data in Research on Survey on Information Processing Activities by Industry. The way of calculation is based on the "Research Report on Comprehensive Indicators of Informatization" by Japan Information Processing Development Corporation (JIPDEC).

The flow of calculation for  $k_i$  in the year  $t$   $k_i(t)$  is shown in Figure 4. First, for each sector, the amount of Hardware Depreciations and Software Investment is aggregated.

The amount of Hardware Capital Stock in the year  $t$   $K_i^h(t)$  is calculated by dividing Depreciations (real value at 1995-price) by Depreciation Rate  $\delta_1^{(5)}$ . Hardware Capital Stock per Employee in the year  $t$   $k_i^h(t)$  is calculated by dividing Hardware Capital Stock by the number of Employees  $L_n^i(t)$ .

The amount of Software Investment per Employee in the year  $t$   $i^s(t)$  is defined as Software Purchase Cost per Employee (real value at 1995-price). Then, Software Capital Stock per Employee in the year  $t$   $k_i^s(t)$  of each sector is calculated by multiplying by , and then totaling them for the past 5 years including the year  $t$  ( $x = 0$  to 4), because the legal durable years of software is 5 years<sup>(5)</sup>.

Lastly, the Information Equipment Ratio of the year  $t$   $k_i(t)$ , is defined as the mean value of the sum of this  $k_i^h$  and  $k_i^s$  in the year  $t$  and the year  $(t-1)$ , because the number of employees in the year  $t$  is the average of the number of employees at the end of the year  $t$  and the year  $(t-1)$  in FSSCI. Therefore, the same technique is employed in calculating not only



Note: This method is used to prepare the data for each sector.

Figure 4. Calculation of The Information Equipment Ratio

$k_i(t)$  but also  $k_o(t)$  (Capital Equipment Ratio).

However, it should be noted that the results of calculation is not considered as two-year moving averages, but they are so-to-speak "interim averages", which indicate the averages of variables in the middle of the year.

### 3.2.2 Labor Productivity

In order to calculate Labor Productivity  $q$ , we have to define Value-added. Value-added in this paper is the sum of Labor Cost, Operational Profit, and Depreciations. We use data of FSSCI.

The equation (3.10) shows how to calculate Labor Productivity for each sector.

$$q(t) = Q(t) / L_n(t) \quad (3.10)$$

where

$q(t)$ : Labor Productivity

$Q(t)$ : Actual amount of Value-added<sup>(6)</sup> (Sum of wage, executive compensation, welfare cost, operating profit, and depreciations)

$L_n(t)$ : Sum of executives and employees on regular basis

### 3.2.3 Capital Equipment Ratio

Capital Equipment Ratio in the year  $t$   $k_o(t)$  is the amount of Capital Stock other than Information Equipment per Employee for each sector, calculated first by subtracting the amount of Hardware Equipment from the amount of Capital Stock  $K(t)$  for each sector, and then by dividing it by the number of employees of the sector. Its calculation is shown in (3.11) below <sup>(7)</sup>.

$$k_o(t) = [K(t) - k_i^h(t)L_n(t)] / L_n(t) \quad (3.11)$$

where

$k_i(t)$ : Capital Equipment Ratio

$K(t)$ : Sum of other Tangible Fixed Assets and Construction in Process Account, in real term deflated by Net Fixed Asset Deflator (corporations other than financial firms, 1995-price) of SNA (System of National Accounts)

$k_i^h(t)$ : Amount of Hardware Equipment per Employee<sup>(8)</sup> (Depreciations data is that of Survey on Information Processing Activities by Industry, real values in 1995-price)

### 3.2.4 Labor Input

Labor Input is the Aggregate Working Hours per Employee in the year  $t$   $h(t)$  for each sector. Firstly, the Annual Aggregate Working Hours in the year  $t$  for each industry is calculated.

$$H(t) = C(t) \times I_m \times 12 \times I_n(t) \quad (3.12)$$

where

$H(t)$ : Annual Aggregate Working Hours for each industry

$C(t)$ : Index of Monthly Aggregate Working Hours for each industry in the Monthly Labor Survey

$I_m$ : Monthly Aggregate Working Hours per Employee for each industry in 2000

$I_n(t)$ : Number of Employees on regular basis for each industry in FSSCI.

Then, by summing up  $H(t)$  for each industry and dividing them by  $L_n(t)$ , we have  $h(t)$  for each sector.

$$h(t) = \sum_{\text{industry}} H(t) / L_n(t) \quad (3.13)$$

## 3.3 Results

Table 1 shows the results of the analysis.

First, let's notice the contribution of Information Equipment Ratio  $\gamma G(k_j)$ .

The observation of  $\gamma G(k_j)$  in time series shows the following inequality holds for the sectors except for Manufacturing Related to Consumption:

$$(\text{Values of 1985-90}) > (\text{Values of 1990-95}).$$

This means that Information Equipment contributed to the improvement of Labor Productivity less in the first half of 1990 than in the second half of 1980. Information Equipment in 1990-95 was the result of the investment around the Bubble Economy, and even in 1991-92, when the collapse of the Bubble became evident to all people, firms still pursued the active IT investment <sup>(9)</sup>. However, from the macro-economic viewpoint, their business performance declined after that, in spite of such huge

amounts of IT investment. Therefore, the declining contribution of Information Equipment in the first half of 1990s can be considered as the result of IT investment during and after the Bubble Economy, when IT investment was regarded as a sacred precinct and it was carried out without sufficient consideration for its effect. Thus, the existence of the Productivity Paradox in Japan is inferred from this result.

On the other hand, the values of  $\gamma G(k_j)$  in 1990-95 and 1995-02 do not show any significant improvement. The contribution of Information Equipment has not improved greatly in 1990s, though its effect is somewhat mixed depending on the type of sector and the scale of corporation. This becomes clear with the following inequality of  $\gamma G(k_j)$  in 1985-90 and 1995-02, which holds for all sectors:

$$(\text{Values of 1985-90}) > (\text{Values of 1995-02}).$$

Table 1. Contribution of Each Input Factor to Value-added Productivity

Sector	Period	G(a) (%)	$\alpha$	G(h) (%)	$\alpha G(a)$ (%)	$\beta$	G(k <sub>j</sub> ) (%)	$\beta G(k_j)$ (%)	$\gamma$	G(k) (%)	$\gamma G(k)$ (%)
Manufacturing	1985-90	6.0	0.67	-0.3	-0.2	0.00	6.1	0.0	0.33	19.0	6.2
	1990-95	1.6	0.71	-1.3	-0.9	0.13	3.9	0.5	0.16	12.6	2.0
	1995-02	4.2	0.71	0.0	0.0	-0.06	2.3	-0.1	0.35	12.3	4.3
Manufacturing Related to Consumption	1985-90	1.2	0.73	-0.9	-0.6	0.30	8.0	2.4	-0.03	19.5	-0.6
	1990-95	0.5	0.76	-1.2	-0.9	0.21	4.2	0.9	0.03	16.3	0.5
	1995-02	-0.3	0.76	0.1	0.1	0.64	2.5	1.6	-0.40	5.0	-2.0
Manufacturing Related to Materials	1985-90	4.5	0.63	-0.2	-0.1	0.13	5.5	0.7	0.24	16.0	3.9
	1990-95	0.7	0.67	-1.1	-0.7	0.32	4.1	1.3	0.01	11.7	0.1
	1995-02	2.5	0.67	-0.1	-0.1	0.22	2.4	0.5	0.11	18.9	2.0
Manufacturing Related to Machinery	1985-90	9.8	0.69	-0.1	-0.1	-0.33	6.8	-2.2	0.64	18.9	12.1
	1990-95	3.0	0.73	-1.5	-1.1	-0.05	3.3	-0.2	0.32	13.3	4.2
	1995-02	6.5	0.72	0.1	0.1	-0.41	2.3	-1.0	0.69	10.7	7.4
Non-Manufacturing	1985-90	4.1	0.73	-0.6	-0.5	0.09	4.3	0.4	0.18	22.7	4.1
	1990-95	-0.3	0.77	-1.2	-0.9	0.29	4.4	1.3	-0.06	11.8	-0.7
	1995-02	-0.5	0.77	-0.9	-0.7	0.27	1.8	0.5	-0.04	6.7	-0.3
Industries Covered	1985-90	4.8	0.70	-0.5	-0.4	0.05	4.9	0.3	0.24	20.2	4.9
	1990-95	0.3	0.75	-1.3	-0.9	0.22	4.1	0.9	0.03	12.2	0.3
	1995-02	1.2	0.75	-0.6	-0.4	0.11	1.9	0.2	0.14	10.0	1.4

The decline in  $\gamma$  contributes greatly in this trend. The following inequality holds for  $\gamma$ , except for Manufacturing Related to Machinery:

$$(\text{Values of 1985-90}) > (\text{Values of 1995-02}).$$

What this inequality means in terms of Growth Accounting Model expressed by (3.1) is as follows:

$$\gamma = (\partial q / \partial k_i) / (q / k_i)$$

so  $\partial k_i$  and  $\partial q$  have a great impact on  $\gamma$ . The decline of  $\gamma$  is caused by the fact that, in spite of the large value for  $\partial k_i$ ,  $\partial q$  did not increase.

### 3.4 Hypothesis

The fact-findings can be summarized as follows.

- 1) The rise in the Labor Equipment Ratio resulted in Labor Productivity.
- 2) Labor Equipment Ratio has chiefly contributed to efficiency improvement in the production division.
- 3) On the other hand, the contribution of Labor Equipment Ratio in the non-production division is very small. Even the possibility of introducing inefficiency cannot be denied.
- 4) In many sectors, as for 1995-02, despite the increase in Information Equipment Ratio, a tendency toward lower Labor Productivity can be seen, comparing with 1985-90.

From these fact-findings, we can derive the hypothesis that the reason for fact-finding 4) is because the Information Equipment was not used efficiently in the non-production division.

To verify this hypothesis, it is necessary to employ analysis-models by which the production division and non-production division are separated. One example of such models is as follows:

$$G(q) = A + \alpha^p G(h^p) + \beta^p G(k_o^p) + \gamma^p G(k_i^p) + \alpha^{np} G(h^{np}) + \beta^{np} G(k_o^{np}) + \gamma^{np} G(k_i^{np}) \quad (3.14)$$

where

$G(X)$ : Annual Growth Rate of  $X$

$$\alpha^p = (\partial q / \partial h^p) / (q / h^p)$$

$$\alpha^{np} = (\partial q / \partial h^{np}) / (q / h^{np})$$

$$\beta^p = (\partial q / \partial k_o^p) / (q / k_o^p)$$

$$\beta^{np} = (\partial q / \partial k_o^{np}) / (q / k_o^{np})$$

$$\gamma^p = (\partial q / \partial k_i^p) / (q / k_i^p)$$

$$\gamma^{np} = (\partial q / \partial k_i^{np}) / (q / k_i^{np})$$

$q$ : Labor Productivity

$h^p$ : Annual Working Hours per Employee in the Production Division

$h^{np}$ : Annual Working Hours per Employee in the Non-Production Division

$k_o^p$ : Capital Equipment Ratio in the Production Division

$k_o^{np}$ : Capital Equipment Ratio in the Non-Production Division

$k_i^p$ : Information Equipment Ratio in the Production Division

$k_i^{np}$ : Information Equipment Ratio in the Non-Production Division

$A$ : Constant indicating the impact of External Factor

However, the verification of such a model is extremely difficult because there are following restrictions in gathering data.

- 1) It is impossible to obtain the value of the information equipment of each division.
- 2) It is impossible to obtain annual working hours per person of each division.

Therefore, to verify the hypothesis, we adopt

the value of Slack calculated by using DEA in Section 4.

#### 4. EFFICIENCY ANALYSIS BY DEA

##### 4.1 D-efficiency and Slack

In the analysis by DEA, the efficiency is measured as the output amount against the input amount. The measured value (D-efficiency)  $\theta$  is

$$0 \leq \theta \leq 1.$$

And it is judged to be most efficient when its value is 1. For instance, Figure 5 shows the amount of inputs (Input 1 and Input 2) against 1 unit of output in a particular sector in the years A, B, and C. In this Figure,  $\theta$  is equal to 1 in the years B and C, and on all the points on the line segment BC,  $\theta$  is equal to 1. Meanwhile,  $\theta$  in the year A is obtained as

$$\theta = OP / OA (<1).$$

In other words, the efficiency in the year A is considered to be lower than in the years B and C, because of the larger input to obtain the same output. In order for the year A to be efficient (that is,  $\theta=1$ ), it is necessary to multiply Input 1 and Input 2 by  $\theta$ , and use them as the inputs at the point P.

Similarly, if the input required for 1 unit of output is as described as the year A' ,

$$\theta = OP' / OA' (<1)$$

holds. If Input 1 and Input 2 are multiplied by  $\theta$ , it moves to P' and the value of  $\theta$  becomes 1. But, as seen in Figure 5, Input 2 is smaller in the year B than in P' . Therefore, in order to be really efficient in the year A', it is necessary to reduce Input 2 by the amount

of P'B. This reduced amount P'B is called slack. Slack is not the kind of factor that can be reduced in the same ratio as other factors, and therefore, it can be considered to have a stronger implication as surplus comparing with the amount of reduction indicated by D-efficiency  $\theta$ .

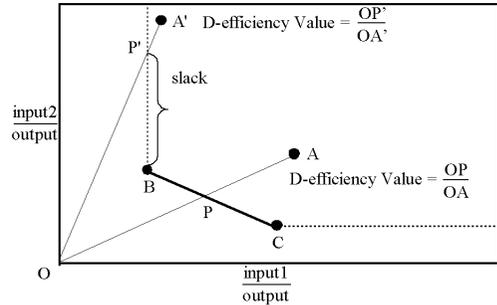


Figure 5. Image of D-efficiency and Slack

#### 4.2 Data

##### 4.2.1 Output Factor

$Q(t)$ : Already calculated by (3.10)

##### 4.2.2 Input Factors

###### (1) Labor Input

It is difficult to obtain data of input factors in the production division and the non-production division directly as described in Section 3.4. Therefore, it is appropriate to make some assumptions and to use the proxy variable.

Here, the following assumption is made: The workers who have college and university background belong to the non-production division. Other workers belong to the production division. And the following proxy variables are used.

$L^{np}(t)$ : Employees in the non-production division = Number of graduates of colleges

and universities, both in the new and old systems, in  $L_n(t)$  (see (3.10)).

$L^p(t)$ : Employees in the production division = the Number of those who finished primary and middle school in the new systems, high school in the old and new systems, vocational high school, and junior college, in  $L_n(t)$  (see (3.10)).

For each industry, ratios of the number of employees who have the above academic backgrounds in each fiscal year, is calculated by the data of the Basic Survey of Wage Structure report. And multiplying these ratios by  $L_n(t)$ , we obtain  $L^{np}(t)$  and  $L^p(t)$ .

As a result, when there is slack in the labor input with college/university graduates, it can be said that the possibility of Slack of labor input in the non-manufacturing division is high.

## (2) Capital Input

$K_o$ : Capital Stock Amount other than Information Equipment (see (3.11))

$K_i$ : Amount of Information Equipment  
(Calculated by  $k_i(t)L_n(t)$ )

## 4.3 Results

We will pay attention to Slacks of the labor input in the production division and the non-production division and that of Information Equipment, to verify the hypothesis in the Section 3.4.

Ahead of that, to verify the validity of the analysis by DEA, it is necessary to confirm whether the change of D-efficiency value reflects the situation of macro-economy.

The results of analysis of D-efficiency is shown in Table 2. In all sectors,  $\theta$  started to decline in 1986 when the depression caused by the strong yen began in response to the

Plaza Accord in 1985. However, during the Bubble period of 1988-91, they increased in all sectors, and became 1 in 1991, showing that all input factors were made effectively use, and lead to the creation of Value-added. Then, due to the impact of the collapse of the Bubble, the number of industries considered to be efficient rapidly decreased. After 1992, a deflation and downturn of new investment were reported. The corporate performance continues to be sluggish, as does the value of  $\theta$ . However,  $\theta$  began to rise again after the fiscal year 1998. Especially, the rise in  $\theta$  in manufacturing sector is remarkable.

Though values of  $\theta$  vary depending on the sectors, its trend is considered to have agreed with the actual feeling about macro-economy during the analysis-period.

Table 3 shows the change in Slacks of  $K_i$ ,  $L^{np}$ , and  $L^p$ . At a glance, it is clear that, in many sectors, Slacks can be seen in  $L^{np}$ , which are employees with college/university degrees. This means that there are many sectors with Slack in Labor Input in the non-production division, since the number of such employees in the production division is very small.

In the latter half of 1990s, the increase in Labor Input of  $L^{np}$  and the reduction of  $L^p$  are a common trend in all sectors. Moreover, Slacks in  $K_i$  exist in all sectors in 1995-02 except for Manufacturing Related to Machinery. Especially in Non-Manufacturing and Industries Covered, Slacks in  $L^{np}$  and increased greatly during the period. The existence of Slacks and relative increase in Labor Input of  $L^{np}$  mean that Information Equipment was used in the non-production division, which did not contribute to production and to creation Value-added.

Table 2. D-efficiency Values  $\theta$  of Each Sector

Fiscal Year	Manufacturing			Non-Manufacturing	Industries Covered	
	Manufacturing Related to Consumption	Manufacturing Related to Raw Materials	Manufacturing Related to Machinery			
1985	1	1	1	1	1	
1986	0.954	0.936	0.942	0.978	0.962	
1987	0.965	0.88	0.975	0.981	0.961	
1988	1	0.98	1	1	1	
1989	1	0.998	1	0.991	0.965	0.980
1990	1	0.944	1	1	1	
1991	1	1	1	1	1	
1992	0.986	0.956	0.958	0.972	0.999	0.994
1993	0.961	0.929	0.948	0.958	0.951	0.949
1994	0.979	1	0.936	0.933	0.967	0.982
1995	0.986	1	0.988	0.912	0.961	0.999
1996	0.936	0.843	0.999	0.925	0.898	0.944
1997	0.952	0.874	1	0.918	0.887	0.959
1998	0.913	0.827	0.935	0.855	0.838	0.906
1999	0.934	0.838	0.955	0.863	0.822	0.915
2000	1	0.859	1	1	0.886	1
2001	1	0.873	0.958	1	0.883	0.995
2002	1	0.852	1	1	0.886	1

From these fact-findings, we can say that there is surplus of labor input in the non-manufacturing division that cannot make efficient use of the Information Equipment, and this resulted in failure of creation of new Value-added. In other words, we can verify that the hypothesis of Section 3.4 is correct.

In the followings, we will make a brief comment on each sector.

In Manufacturing Related to Consumption, no Slack is seen throughout 1990-02 in  $L^p$ , but it does exist in  $L^{pp}$ . Slacks are also seen in  $K_i$  after 1995. Slacks in both factors, seen after 1990, are a sign that Information Equipment is not utilized effectively in the non-production division.

Similar trends can be seen in Manufacturing Related to Materials. In Manufacturing Related to Materials, Slack in Information Equipment first appeared in 1995-02. The increasing trend of Slacks in  $L^{pp}$  and the zero Slack in  $L^p$  after 1990 are interpreted as indication of high possibility that the non-production division, to which most of  $L^{pp}$  belongs, did not success to make effective use of Information Equipment.

In Manufacturing Related to Machinery, Slack in Information Equipment cannot be seen throughout the period, unlike other sectors. And, some slacks are seen in  $L^{pp}$  and  $L^p$ , which seems to require more detailed analysis.

Table 3. Sector-Average of Slack Values

Sector	Period	$K_i$ (in millions of yen)	$L^{pp}$ (in thousands of person)	$L^p$ (in thousands of person)	
Manufacturing	1985-90	0.0	3.4	4.2	
	1990-95	0.0	122.6	0.0	
	1995-02	11.6	28.1	0.0	
	Manufacturing Related to Consumption	1985-90	18.3	0.9	43.7
		1990-95	6.2	2.7	0.0
		1995-02	61.7	24.4	0.0
	Manufacturing Related to Materials	1985-90	0.0	1.0	16.8
		1990-95	0.0	24.4	0.0
		1995-02	14.2	12.2	0.0
Manufacturing Related to Machinery	1985-90	0.0	8.1	23.9	
	1990-95	0.0	35.8	0.0	
	1995-02	0.0	27.3	114.0	
Non-Manufacturing	1985-90	0.0	5.4	84.0	
	1990-95	313.2	3.4	0.0	
	1995-02	1721.0	316.3	0.0	
Industries Covered	1985-90	0.0	0.0	86.1	
	1990-95	33.8	94.7	0.0	
	1995-02	905.7	109.0	0.0	

Meanwhile, Slacks in the Non-Manufacturing sector are distinctive. Slack in  $K_i$  appeared greatly in 1990-95, proving the excessive investment during the Bubble period. The Slack increased further in 1995-02. On the other hand, in spite of the zero Slack in  $L^p$  throughout the period, Slacks are seen in  $L^p$  throughout the period. Moreover, though they diminished in 1990-95, they increased greatly again in 1995-02. The Non-Manufacturing sector, where the production of goods is minimal, has a relatively small portion of jobs that can be replaced or substituted by computers, compared with the Manufacturing sectors. In other words, it is this sector where the creation of Value-added by the effective use of computers is strongly required. However, as Table 3 shows, the possibility is very small that this purpose has been accomplished, and this sector has much room for improvement in this sense.

These results suggest strongly that Information Equipment is not utilized effectively in the non-production division in Japan, which confirms the results of Growth Accounting analysis.

Therefore, one of the crucial factors of the decline of Labor Productivity in Japan is the inability on the part of white-color employees to create Value-added by making effective use of Information Equipment.

## 5. Conclusions

In this paper, the hypothesis about the use of Information Equipment on the non-production division was derived from the fact-findings of the analysis of financial indicators and the Growth Accounting, and the

hypothesis has been verified by DEA.

In summary, although the cause of the improvement of labor productivity was mainly due to the rise of Labor Equipment Ratio seen in Section 2, the contribution of the Labor Equipment Ratio in the non-production division was smaller than that in the production division.

In Section 3, we showed that, even though the Information Equipment Ratio increased in the latter half of 1990's comparing with the latter half of 1980's, its increase was not necessarily linked with improvement of labor productivity. These results mean that the non-production division did not succeed to make effective use of Information Equipment, which we verified by making use of DEA in Section 4.

In general, the process whereby enterprises create the value-added is critical: the non-production division creates ideas of new commodities, and the production division produces them, then the non-production division does promote sales, and further manages activities of the enterprises as a whole. In almost all processes, the information equipment is closely related to these activities. However, in view of the analysis result, the information equipment contributes to the production division more than to the non-production division. That is, it can be said that there is a bottleneck in the above process of creation of the value-added, particularly in the non-production division side, which did not succeed to achieve improvement of the labor productivity by using information equipment.

It is partly because the aims of introduction of information system into business process have shifted from the standardized business

operations to non-standardized ones. At early stages, automation-system and robots were introduced to improve manufacturing efficiency in the production division and, in the non-production division, the introduction of the accounting information system and others were attempted to improve efficiency of clerical work. However, after these stages, the purpose of introducing the information system has been shifting toward a qualitative improvement of non-standardized business operations, that is, to grasp customer needs and to speed up strategic decisions etc.

There has been a change from the stage where mere improvement of effectiveness of standardized operations connected directly with the strengthening of competitiveness, to the stage where the strengthening of competitiveness would be obtained by utilizing the advantages of information system both in the production and non-production divisions. Unfortunately, we cannot help but say that the results of this paper show the delay of the response of the non-production division to adopt this change.

These days, the organizational structure and recruit and training of skilled employees become especially important because they make it possible to raise efficiency of non-standardized business operations in the non-production division and thus create new value-added for enterprises as a whole.

In order to assess the importance of the organizational structure and recruit and training of skilled employees and quantitatively to analyze the effects of information system on them, it is inevitable to build models which include organizational elements and skill of the employees.

However, it is not so easy to build such models and, moreover, the restriction of data is a big hurdle. Particularly, it is not possible to analyze the production and non-production divisions directly. It is a reason why an assumption was made about labor input, and the proxy variable had to be used in this paper.

Relevant model-buildings, data-gathering and finding of suitable proxies are tasks for the future.

## 6. Appendix

The process by which the equation (3.9) is derived is as follows.

Let's think of the following Cobb-Douglas production function:

$$Q = AL^\alpha K_o^\beta K_i^\gamma \quad (6.1)$$

where

$Q$ : Value-added

$A$ : Constant indicating the impact of External Factor

$L$ : Labor Input= Annual Working Hours per Employee x the number of Employees

$K_o$ : Capital Stock other than  $K_i$

$K_i$ : Information and Communication- related Capital Stock

Assuming homogeneity of degree 1, the following equations hold:

$$\alpha + \beta + \gamma = 1$$

$\alpha$ : Share of Labor, i.e.  $\alpha = \frac{wL}{Q}$

$w$ : Wage Rate

$\beta$ : Share of Capital Stock other than  $K_i$

$\gamma$ : Share of Information and Communication- related Capital Stock.

After dividing both sides of (6.1) by the

number of Employees, then differentiating, we have

$$\frac{\Delta q}{q} = \alpha \frac{\Delta h}{h} + \beta \frac{\Delta k_o}{k_o} + \gamma \frac{\Delta k_i}{k_i} \quad (6.2)$$

where

$q$ : The amount of Value-Added per Employee

Employee

$h$ : Annual Working Hours per Employee

$k_o$ : Capital Equipment Ratio

$k_i$ : Information Equipment Ratio

$$\alpha = \frac{wh}{q}$$

Then

$$\begin{aligned} \frac{\Delta q}{q} &= \frac{wl}{q} \frac{\Delta l}{l} + \left(1 - \frac{wl}{q} - \gamma\right) \frac{\Delta k_o}{k_o} + \gamma \frac{\Delta k_i}{k_i} \\ &= \left(\frac{\Delta k_i}{k_i} - \frac{\Delta k_o}{k_o}\right) \gamma + \frac{w}{q} \Delta l + \left(1 - \frac{wl}{q}\right) \frac{\Delta k_o}{k_o} \end{aligned}$$

This equation is solved for  $\gamma$ .

$$\begin{aligned} \left(\frac{\Delta k_i}{k_i} - \frac{\Delta k_o}{k_o}\right) \gamma &= \frac{\Delta q}{q} - \frac{w \Delta l}{q} - \left(1 - \frac{wl}{q}\right) \frac{\Delta k_o}{k_o} \\ \therefore \gamma &= \frac{\frac{\Delta q}{q} - \alpha \frac{\Delta l}{l} - (1 - \alpha) \frac{\Delta k_o}{k_o}}{\frac{\Delta k_i}{k_i} - \frac{\Delta k_o}{k_o}} \end{aligned}$$

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### Notes

(1) This paper is a revised version of the following paper: Hiromatsu, T., Ohira, G., Kobayashi, M., Tsubone, N., Kurita, M., "A Quantitative Analysis on the Impact of the Usage of Information Equipment in Non-productive Division", *Journal of Social Informatics* Vol.16, No.1, pp. 43-58, 2004. We made re-calculations by using updated data and rewrote remarks and conclusions.

(2) Industries included in each sector are as follows:

Manufacturing Related to Consumption

Food, beverages, tobacco, feed

Textile mill products

Apparel and other finished products made from fabrics and similar materials

Manufacturing Related to Materials

Pulp, paper and paper products

Chemical and allied products

Ceramic, stone and clay products

Iron and steel

Non-ferrous metal and products

Fabricated metal products

Manufacturing Related to Machinery

General machinery

Electrical machinery, equipment and supplies

Transportation equipment

Precision instruments and Machinery

Manufacturing

All the above industries

Non-Manufacturing

Construction

Wholesale and retail trade, eating and drinking places

Transport and communications

Electricity, gas, heat supply and water

All Industries

All the above industries

(3) It is assumed that the rises in the Labor Equipment Ratios are equal both in the production division and the non-production division.

(4) For more details, refer to 6.Appendix.

(5) The legal durable years of the personal computer were changed from 6 to 4 years after the fiscal year 2001, and that of the computer other than the personal computer were changed from 6 to 5 years, respectively. However, in this thesis, 6

years was used as the durable years because the majority in the analysis period (1985-2002) of Sections 3 and 4 are before these revisions.

And the durable years of software was also revised from 5 to 4 years after the fiscal year 2000. However, in this paper, 5 years is used for the reasons similar to the computer.

- (6) We change nominal values into real values by making use of 1995 GDP-deflator.
- (7) In the majority of the analysis period (1985-2002), the depreciation of software is not recorded in Corporate Financial Reports. Therefore, the Capital Equipment Ratio was calculated by deducting only the Information Equipment calculated by the Depreciation of Hardware from  $K(t)$ .
- (8)  $k_t^b(t)$  is an "interim average" or "mid-of-the-year average" calculated by the relevant end-of-the-year data.
- (9) In Japan, it was in 1993 when the sales of information service industry turned to decline for the first time.

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# A particular relationship between the icon on the desktop and the programming language

Keywords:

Icon, Allegory, Interface, PYGMALION, Smalltalk

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## Abstract

This paper examines a relationship between the icon on the desktop and the programming language, in order to examine the icon's significance in the Graphical User Interface.

In order to explore this relationship, my paper regards the icon as a pictorial sign and the programming language as a linguistic sign. I can then consider this relationship as a special case of battle between the pictorial sign and the linguistic sign throughout cultural history. I then focus on David. C. Smith's doctoral thesis PYGMALION, which introduced the icon concept for the computer, and the programming language for PYGMALION, Smalltalk, in order to investigate what the icon brings to the computer and why the icon is even possible. Next, I analyze why the linguistic sign becomes the pictorial sign from the viewpoint of analogy and allegory. Finally, my paper shows what is concealed by the desktop icon.

Through these analyses, we can say that the relationship between the icon and the programming language is one of allegory and complementariness. This means that the icon is a pictorial sign, restricted metaphorically by the linguistic sign, the computer program.

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## 1. Introduction

In the information society, almost all of us look at the computer display which shows the surface called the 'Desktop'. There are many icons on the Desktop and we select and click them with the mouse everyday. However, we don't give consideration to what the icon is on the computer display. Therefore, Barbara Maria Stafford writes the following about the icon: "At the close of the twentieth century, it should give us pause that we still lack a flexible method for orchestrating the jumble of discrete emissions and darting blips that swim across countless monitors. They remain a hermetic system of graphic symbols for which we have lost the analogical key (Stafford, 1999 : 55). "It is time to find the analogical key. To that end, this paper examines the icon's significance not from the viewpoint of Information science but from the relationship between pictorial and linguistic signs.

In order to explore this relationship, my paper regards the icon as the pictorial sign and the programming language as the linguistic sign. We can then consider this relationship as a special case of battle between the pictorial sign and the linguistic sign throughout cultural history. Next, I focus on David. C. Smith's doctoral thesis, PYGMALION, which introduced the icon concept for the computer. We look at the programming language for PYGMALION, Smalltalk, in order to investigate what the icon brings to the computer and why the icon is even possible. I make reference to Leibniz because Alan Key, the advocate of Smalltalk, thinks that Smalltalk has much in common with the monads of Leibniz (Kay, 1993 : 70).

Moreover, we analyze why the linguistic sign becomes the pictorial sign from viewpoint of analogy and allegory. Finally, this paper shows what is concealed by the icon on the desktop.

## 2. The icon as pictorial sign and the programming language as linguistic sign

M. J. T. Mitchell points out that "the history of culture is in part the story of a protracted struggle for dominance between pictorial and linguistic signs, each claiming for itself certain proprietary rights on a "nature" to which only it has access (Mitchell, 1986 : 43)." From Mitchell's view, we can think of the computer as having both signs: the icon as the pictorial sign and the programming language as the linguistic sign. In the computer, the programming language generates the icon, but we can not actually look at the programming language, but only at the icon on the display of Graphical User Interface (GUI). Which of both these modes signs is dominant in the computer? We consider that the computer display with GUI is a contemporary struggle field for dominance between the pictorial and linguistic signs.

In order to investigate this relationship, I focus on the word "nature" in Mitchell's text. What kinds of "nature" do the icon and the programming language are approaching? The icon has brought the idea of "easy to use" into the computer world. Consequently we can say that the icon allows the computer user to recognize the situation of the computer "naturally". What about the programming language? The programming language is one of many artificial language which people have made for recognizing and communicating

special information efficiently, like numerical formulae or a chemical formulae. Therefore, the programming language is also a tool to facilitate our recognition. However, it has a unique characteristic which no other artificial languages have. According to Levine & Reingold, the computer is the first machine able to follow linguistic instructions (Levine & Reingold, 1987: xvi). Therefore the programming language has to communicate not only to people but also to the computer. Haruki examines the programming language from the viewpoint of communication of human thought, and writes its characteristics as follows:

The programming language as an artificial language sends an instruction to the Central Processing Unit (CPU). If we view this action from a different angle, we can think of it as a conversation between the human and CPU. With other artificial languages it is supposed that humans communicate with humans, but with programming language, it must be presumed that the CPU is the other half of the communication partnership. Moreover, CPU can understand only von Neumann logic and never tries to learn other languages. Therefore, the first purpose of the programming language is to be able to communicate between the CPU and humans (Haruki, 1989: 30-31).

Von Neumann logic is the basic architecture of the computer which has never changed since the beginning of the computer. It is a design model that uses a processing unit and a single separate memory to hold both instructions and data. In von Neumann

architecture, "a structure of the main memory ability is linear and processes a basic task sequentially based on a program counter in the CPU. Therefore, we have to make a sequential process with data corresponding to the memory unit and task corresponding with the processing unit if we want to write a problem as a computer program (Haruki, 1995: 203). "From this computer principle, the linguistic sign has absolute dominance over the computer because the linear structure of language is suitable for controlling the CPU sequentially.

However, D. C. Smith tried to control the CPU with icons in the computer display in order for the pictorial sign to gain dominance on the CPU. Smith's challenge introduced a metaphor which shows a link between the real world and the computer world. After that, the spread of GUI which controls the computer with icons has created "a metaphor space mediated by information technology" (Ishida, 2003: 332) onto the computer display. It represents a revolution from linear programming language to the icon as a non-linear information display. Therefore, GUI has signaled the end of the absolute dominance of the linguistic sign and initiated the beginning of the dominance of pictorial sign in the computer. However, it is important to consider that the metaphorical space on the computer display is created from the programming language which has a unique property. This change shows that the pictorial sign and the linguistic sign continue fighting each other for proprietary rights on a "nature" to which only each of them can access in the new stage, the computer. For that reason, it is useful to consider the relationship between

the icon and the programming language from the viewpoint of the pictorial sign and the linguistic sign in order to make clear what the icon is on the computer display. For that purpose in the next section, I refer to D. C. Smith's PYGMALION and consider what has been the impact on the computer of the introduction of the icon as pictorial sign.

### 3. Complementarity of the icon and the programming language

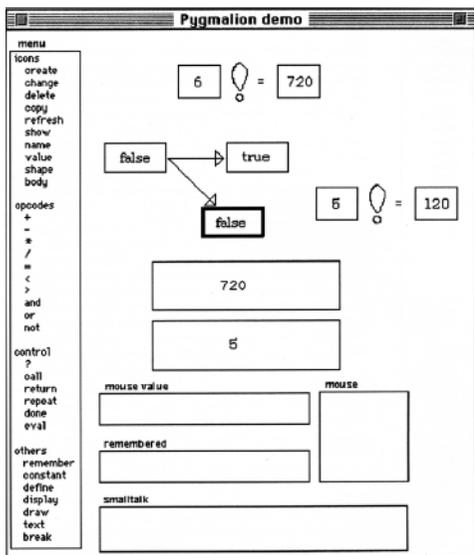


Figure 1. Pygmalion on Macintosh (Smith, 1993: 31)

In 1975, D. C. Smith introduced the icon into the computer world with his doctoral thesis "PYGMALION: A creative programming environment" and now we take for granted that there are icons on the computer display. In his thesis, Smith defined the icon as follows:

Communication between user and computer is through a primitive visual entity called an "icon". Icons possess several visual

and mechanical attributes. The system maps the visual characteristics of icons into corresponding machine semantics. Icons subsume the notions of "variable", "reference", "data structure", "function" and "picture" (Smith, 1975 : iv).

From his definition, we can understand that the icon is not only the pictorial form of information but also the connection with the linear structure of data of the computer memory. I will consider why Smith adopted the pictorial sign as the information display form for the computer. When he made a complete volte-face from the linguistic sign to the pictorial sign, his greatest purpose might have been to introduce the non-linear information display principle into the computer because he referred to the difference between the word and the picture again and again in PYGMALION as follows:

In other words, the relationship between pictorial elements has as much to do with spatially- derived meaning as with the elements themselves. But "linear" programming languages have no spatial structure at all. (By "linear" is meant a verbal language such as English, constituting of a sequence of words.) One of the few characteristics of "linear" languages that even approach spatial organization is indentation:

```

IF ..... THEN
    WHILE ..... DO
        BEGIN
            .
        END
    ELSE

```

At best this is only an indirect indicator of meaning. The vast potential of multidimensional communication is simply not realized in linear languages because they are spatially unstructured (Smith, 1975: 12-13) .

In short, Smith compared the linearity of the word with the spatiality of the picture and argued that the pictorial sign was much better for information display than the linguistic sign. Further, he explained the relationship between the linguistic sign and the pictorial sign using the words "Fregean" and "Analogical". Smith quoted these two words from Aaron Sloman's thesis which subtitled "the role of intuition and non-logical reasoning in intelligence". Sloman wrote that analogical representations such as maps or models were much more useful for "intuition and non-logical reasoning" than the "Fregean" mode of representation, named after logician and philosopher, Friedrich Ludwig Gottlob Frege, that was utilitarian tool suited to our reasonable logic (Sloman, 1971). From Sloman's idea, we can say that the alphabet is most Fregean mode of representation because it is at a high level of abstraction of the object being expressed.

As already noted, the computer is a logical machine which has linguistic ability. Therefore the instructions to the computer must be logical. As a result, the computer program is composed of linguistic sign which can think in abstractions and depict things logically. J. D. Bolter insists that the computer generates new space for the linguistic sign and writes about the relationship between the logic and the computer program as follows:

Computer programming is simply the newest version of symbol manipulation that mathematicians and logicians have practiced for centuries. Programming is embodied logic: the establishment of logical relationships among symbols that are embodied in and empowered by the memory chips and processors of the digital computer. Mathematics has been a special kind of writing at least since the evolution of modern notation in the 17th century. The set of mathematical equations that defines a physical theory is a symbolic text of the highest order. And science itself has been a formal language since the time of Descartes and Leibniz, or indeed Galileo with his claim that the book of nature was written in the language of mathematics. In the 19th and 20th centuries, the desire to make language formal and rigorous has led to modern symbolic logic, to semiotics, to logical positivism, and ultimately to computer programming (Bolter, 1991: 9-10).

Even though the computer programming is the latest version of logical operation that has made the linguistic sign more formal and rigorous, Smith dared to introduce into computer programming the pictorial sign which is much more useful for "intuition and non-logical reasoning". He wanted to adopt a way of intuitive description for computer programming. The pictorial description allows us more creative programming beyond logic so that what is written can be understood at first sight (Smith, 1975).

Although the dispute as to whether human thinking is based on the word or the image is

still not settled, Smith considered that human thought was generated from the image because he regarded Rudolf Arnheim's "visual Thinking" (Arnheim, 1969) as important. Therefore, Smith concluded that the linguistic sign for the programming language was too rigorous for the programmer. Also, there was a gap between the user's visual thinking and the computer using the linguistic sign as information display. The gap had to be closed by the programmer or the computer. From the birth of the computer, the programmer had to convert his/her thought into formal and rigorous linear language in order to close the gap. However, as the computer developed the gap grew too big to fill. Smith's PYGMALION introduced into computer programming the pictorial sign a form analogous to human thinking, thus closing the gap and making the program more natural for the user.

Using the pictorial sign as the icon, PYGMALION brought a visual map into the computer display to control the linear data processing of the computer. This map released the user from the rigorous linear language which was difficult to understand at first glance. Icons, however, are much easier for us to understand because they give visual clues of their own information. On the other hand, one can say the pictorial sign is forced on the computer in order to help the information display coincide with the way of human thinking since the computer has its own very different principle of linear data processing. How could Smith do that? Michel Serres gives a hint as to the answer. He says that there are two orders in the mathematical language which is the most formal and rigorous artificial language:

As for me, I cannot understand B without advance knowledge of A. Conversely, I need B and its continuation in order to understand A. However, we must make sure what the irreversibility is here because the irreversibility does not belong to the mathematical essence, strictly speaking. If anything, there are two mathematical orders. One is to find a solution, so it is irreversible. As we know, people go from unknown to known, from simple to complex and from easy to difficult. Although this is the way to discovery, this is not the order of the mathematical world. It is the order of the mathematician's practice. In fact, the order of mathematical world is limitless reversibility. Even though we cannot say that everything is irreversible, there are many ways to one concept or idea. Leibniz, a philosopher with multiple view points and an ambiguous system, knows this (Serres, 1968a = 141).

Serres divides the mathematics into two parts; one is the mathematical world which has reversibility. It is based on Leibniz. The other is the mathematician's practice which is irreversible because it has to find a solution. In the computer with von Neumann architecture, linear order is superimposed on the order of the mathematician's practice. However, Ivan Sutherland who developed the first computer graphic system: Sketchpad points out that "The sequential approach to mathematics is not required inside a computer, but the mathematical approach we normally take to problems does not encourage us to think of approaches other than sequential ones for the solution of problems. Nearly all computers in operation today

perform individual steps on individual items of data one after another in time sequence (Sutherland & Mead, 1977: 210). " In short, although the mathematical approach and the characteristic of the computer make the information processing in the computer sequential, linear and the irreversible, it is not an essential property for the computer because it is just "the order of the mathematician's practice" as Serres said and "The sequential approach to mathematics is not required inside a computer" as Sutherland said.

Well, mathematics as an artificial language is linear and processes data step- by-step. This is especially true of algebra. However, mathematics has another field, geometry, which deals with the pictorial sign. In mathematics, geometry and algebra are one aspect of the struggle between the pictorial sign and the linguistic sign. Mitchell writes about the relationship between geometry and algebra as follows:

The other analogy which offers itself is the relationship between algebra and geometry, the one working by arbitrary phonetic signs read progressively, the other displaying equally arbitrary figures in space. The attraction of this analogy is that it looks rather like the relation of word and image in an illustrated text, and the relation between the two modes is a complex one of mutual translation, interpretation, illustration, and embellishment. The problem with the analogy is that it is too perfect: it seems to hold out an impossible ideal of systematic, rulegoverned translation between word and image. Sometimes an impossible idea can be useful,

however, as long as we recognize its impossibility. The advantage of the mathematical model is that it suggests the interpretive and representational complementarity of word and image, the way in which the understanding of one seems inevitable to appeal to the other (Mitchell, 1986 : 44-45).

In this quotation, Mitchell shows that algebra which is solved linearly is translated into geometry which is solved by arranging arbitrary figures in space and vice versa. Although he remarks on the impossibility of the too perfect analogy, he concludes that algebra and geometry need each other in order to understand themselves. Therefore it suggests to us "the interpretive and representational complementarity of word and image." From Mitchell's idea, we may consider that the icon gives us a way to escape from abstract and linear programming language composed of strict logical statements because Smith displays the icon in the computer screen in order to apply the complementarity of the linguistic sign and the pictorial sign. This idea of the complementarity of the icon and the programming language reminds us of Serres' statement that "we must think things by arranging them in an expressive space instead of making a line (Serres, 1968b : 31) " in order to understand the system of Leibniz. Furthermore, this makes it possible to think that we can control the linear processing of von Neumann logic not by the linear language, but by a matrix composed of putting the pictorial signs on the surface one after another, in other words, "putting arrangements of multiple lines alternately

(Serres, 1968b : 31). "Therefore, Smith could introduce the new concept for the computer world, the icon, which connects with functions of the computer in order to control its linear information processing, not by the linguistic sign, but the pictorial sign.

However, Haruki points out that "all things are described progressively in the world of the von Neumann computer, so that non-progressiveness is excluded(Haruki, 1995 : 222-223). "Moreover, Serres writes that "a line is a set and a sequence law at the same time (Serres, 1968b: 32). "Serres's comment is consistent with the von Neumann architecture computer which processes data linearly. As these statements suggest, we have to consider whether the complementarity of the linguistic sign and the pictorial sign comes into effect in principle in the computer world. Then, why did Smith introduce the icon into the computer against the linearity of the computer world? In order to make this question clear, we need to examine Alan Key's Smalltalk, an Object-oriented programming language, because it is what made PYGMALION possible.

#### 4. "The order of co-existences" generated from Information hiding

Smalltalk, proposed by Alan Kay in Xerox Palo Alto Research Center (PARC), is the first object-oriented programming language. Kay described Smalltalk characteristics as follows:

Smalltalk's design--and existence--is due to the insight that everything we can describe can be represented by the recursive composition of a single kind of behavioral

building block that hides its combination of state and process inside itself and can be dealt with only through the exchange of messages. Philosophically, Smalltalk's objects have much in common with the monads of Leibniz and the notions of 20th century physics and biology (Kay, 1993 : 512-513) .

Moreover, Levine and Rheingold wrote that Smalltalk did not improve old programming languages, but rather introduced a new idea into the computer programming;

Smalltalk was one of the first and most spectacular creations of the generation of programmers who had grown up using interactive programming, ever-faster transistorized components, and ever-growing memory capacities rather than the old batch-processed, tube-based, limited-capacity computers of the FORTRAN and COBOL era. With Smalltalk came a new metaphor of computation as a system of software objects, all containing their own data and instructions and carrying on computations by exchanging messages rather than by performing instructions. Smalltalk was more than another computer language. It was a portal to whole new way to think about what computation is and what it can do (Levine & Rheingold, 1987 : 216-217).

Here, we want to consider why Smalltalk could present such a new way for computer programming? Haruki suggests a principle of Information hiding which means that information inside an object is hidden from other objects, and objects cannot interfere with each other. This is an important idea for

Smalltalk:

Although the object is just a structure which hides its own inside information from other objects on implementation, this mechanism of Information hiding has a special effect. We can say that almost all advantages of object-oriented are offered by Information hiding. Due to the hiding of inside information of implementation from the other objects, we can deal with the object as "entity" and as implementation which has successive memory space in memory units separately at the same time (Haruki, 1986 : 60).

As already stated, the von Neumann computer can process units of information only but simultaneously and its memory is a linear structure. However, Smalltalk uses Information hiding in order to write a computer program without awareness of the linear information processing. In short, Smalltalk adopted negative action "hiding" in order to divide information processing into the linear one and the non-linear one. This distinction of the information processing makes it possible to show non-linear element, "picture" as an interface layer to the user while at the same time hiding linear elements, "variables", "reference", "data structure", "function" as a CPU layer from the user. Therefore, Information hiding creates new space in which many objects as information entity exist simultaneously without a linear hierarchy system and can send messages to each other. However, we have to examine what kind of order system this new space is without the linear hierarchy, which is generated from information. In order to make

it clear, we refer to Leibniz's idea of space because Kay believes that Smalltalk's objects have much in common with the monads of Leibniz:

As for my own opinion, I have said more than once that I hold space to be something merely relative, as is time: that I hold it to be an order of co-existences as time is an order of successions. For space denotes, in terms of possibility, an order of things which exist at the same time, considered as existing together, without inquiring into their particular manner of existing. And when many things are seen together, one perceives that order of things among themselves. (Leibniz, 1715 = 1969: 682)

Leibniz called space "an order of co-existences." What does it mean? Yoneyama provides a useful guide to this question when he points out that Leibniz called music "Hidden arithmetic", the word "Hidden" being the most important for understanding the music:

Leibniz grasped that music was subordinated to arithmetic, and argued that a the pleasure of music, or a complex representation such as enjoyment generated from consonance and dissonance existed in "Hidden arithmetic." It is very interesting and attaching the word "Hidden" to arithmetic is important. In order to understand its importance, let us put it aside for the present. In short, we say "the joy of the music is the arithmetic." Namely, we are aware of the arithmetic. In fact, we cannot enjoy the music immediately when we are aware of the

arithmetic in the music, for example, by counting or analyzing rhythm or chord structure. These are already other things from what we feel in the rhythm or beauty of chords. (Yoneyama, 1999: 198).

Although many scholars like Leibniz and Yoneyama consider that music and mathematics are similar, it is important that the music hide its arithmetic process in order to give us pleasure. Yoneyama points this out from Leibniz's expression, "Hidden arithmetic." Now, we return from this view of music to Leibniz's idea that the space is "an order of co-existences". Music is not just built of musical notes. Music appears when it hides its own arithmetic process, adding musical notes, in time, and we enjoy the "order of things among themselves." Therefore, we can say that Leibniz's "order of co-existences" is a relationship of many things which are result from the moment the process of arithmetic is hidden to us.

From the above, we can conclude that the non-linear information processing in the von Neumann computer put into practice by Kay's Smalltalk, and its own principle of Information hiding are deeply very similar to Leibniz's "order of co-existences" generated from hiding its time. In conclusion, to hide the arithmetic process based on time generates "an order of co-existences" as space from absolute order, CPU's linear information processing in the idea of object-oriented. And, "an order of co-existences" gives the von Neumann computer an ideal space for mapping with pictorial signs, namely, the icons. Therefore, we can say that this is what makes for Smith's icons, to control CPU on the

computer display.

##### 5. An allegorical relationship between the icon and the computer program

As in previous sections, we make clear that the icon has a strong connection with the program which also has a connection with CPU's linear information processing. In such a connection, Smalltalk actualizes non-linear information processing by Information hiding and generates new space with "an order of co-existences" in the computer world. As a result, the pictorial sign, icon, can be placed on the computer display. However, we don't know yet why the linguistic sign --- the program in the layer of CPU--- becomes the pictorial sign as the icon in the layer of interface. In order to explain it, we now investigate next the relationship between the icon and the program from the viewpoint of analogy and allegory.

As already explained, the programming language communicates not only with the user but also the CPU. Because the programming language had become an incomprehensible one for us, Smith tried to create a new environment for conversation between the computer and the human being in the computer world by transforming the incomprehensible linguistic sign to the pictorial sign-the icon. And, based on the idea of "superimposing the world in the machine onto the world in the human being metaphorically (Nishigaki, 1994:70)," the icon became something which had to resemble something in the real world. After that, the computer display became "the desktop" because the linear information processing in

the computer was made to connect with the real world by the pictorial sign generated from the principle of analogy: the icon had to resemble something in the real world.

Based on the idea of synchronizing the computer with our style of thinking, Kay and Smith introduced the pictorial sign into the computer by hiding the linear information processing that is generated by the von Neumann logic. However, we need to remember that the indication of the pictorial sign is just useful for us and is the extra work for the computer. Moreover, as Haruki wrote "there is no conversions of the information itself, even though some information is shown to us visually (Haruki, 1989: 144)" in the computer. After all, hiding the process of linear processing is also generated from linear processing with the linguistic sign. From the viewpoint of information processing, information depicted in pictorial signs is not different from the information depicted in linguistic signs. Nevertheless, the problem continues as to why the linguistic sign can become a pictorial sign in linear information processing.

Now, we must put aside the viewpoint of information processing in order to make the above question clear. Instead of that view, we must try to adopt the new view that the icon has not only an analogical relationship with the real world but also metaphorical relationships with the programming language because metaphor is a process which connects language with the picture. From this new view of the relationship between the icon and the programming language, we can uniquely explain how the program produces the icon in the computer world. First of all, let us

consider what the analogy is, because it creates the metaphorical relationship. Leibniz wrote about when explaining the analogy in his "What is an idea?":

An analogy is said to express a thing in which there are relations [habitudines] which correspond to the relations of the thing expressed. But there are various kinds of expression. For example, the model of a machine expresses the machine itself, the projective delineation on a plane expresses a solid, speech expresses thoughts and truths, characters express numbers, and an algebraic equation expresses a circle or some other figure. What is common to all these expressions is that we can pass from a consideration of the relations in the expression to knowledge of the corresponding properties of the thing expressed. Hence it is clearly not necessary for that which expresses to be similar to the thing expressed, if only a certain analogy is maintained between the relations. (Leibniz, 1678 = 1969 : 208).

In Leibniz's idea for the analogy, we want to focus on his point that "it is clearly not necessary for that which expresses to be similar to the thing expressed." Because of a separation of the thing and the thing expressed, Leibniz shows us that it possible to consider that there is no resemblance what it represents in the analogical relationship. It is not important for the analogy to resemble what it represents in appearance but it must maintain some correspondence which shows they are the same thing. Likewise we can suppose that there is an analogical relationship if the icon maintains a

corresponding relationship with the programming language. Moreover, the computer programming language can make the corresponding analogy with its own logic. This is a large difference from the language of humans. In "A theory of computer semiotics," P. B. Andersen explains this as follows:

*The model system is generated from the system description.* Since there may be system descriptions that are not read by any system generator, system descriptions can occur without model systems, whereas model systems must be described by a system description. Therefore, model systems presuppose system descriptions. This assumption motivates a negative answer to our thematic question, "are there sound analogies between computers and humans" for the following reason: if program executions correspond to language usage, there is a difference between the system and usage concepts of informatics and linguistics, since in informatics, usage presupposes a system description, whereas in the linguistic variant I use, usage is of course possible without system descriptions: computers cannot do anything without descriptions, but people can. (Andersen, 1990: 125) [Emphasis is in the original]

In short, the relationship described by the computer programming language is an absolute order for the logic world which the human gives to the computer. It means that we can decide what a word in the programming language indicates at will and must annul the arbitrariness of language. As a result, the programming language is given

some possibility for directly-opposed ideas; defining a rigorous meaning of word and making infinite links of analogy.

From these two possibilities of the programming language, we want to say that the linear program language pursues the strict meaning of a word and the object-oriented program language is open to infinite links of analogy. The reason is that, although the former is an analytical language system which works by defining a word meaning rigorously in order to describe the logic of CPU, the latter works by making links because the objects in the object-oriented programming language hide their own definitions which define the object itself, show their functional appearances, and generate analogical links between each other based on their appearances. However, the CPU's powerful von Neumann logic outside the language interferes with the programming language system in the computer. In terms of this point, the linear programming language and the object-oriented language are the same condition. Therefore, the computer program must be written for processing exactly, based on the von Neumann logic. Namely, the computer programming language keep to describe its own relationship by itself, but it is not a free relationship because CPU compels the programming language to make its own relationship which works on CPU.

Here, we consider that linguistic signs make their own absolute relationship by themselves in the computer world, and the object-oriented programming language generates the analogical links. Therefore, the analogical links have their own absolute relationship in the computer. Next, we refer to the work of

Angus Fletcher in order to make clear what the analogical relationship with the absolute relationship means. He writes "Let us suppose then that the proper analogue to allegory is the compulsive syndrome (Fletcher, 1964 : 286) ," he points out further that the linguistic sign tightly connects with the visual image in the allegory and that "Allegory perhaps has a 'reality' of its own, but it is certainly not of the sort that operates in our perceptions of the physical world. It has an idealizing consistency of thematic content, because, in spite of the visual absurdity of much allegorical imagery, the relations between ideas are under strong logical control. (Fletcher, 1964: 105) " In his other book, Fletcher examines the connection between the linguistic sign and the pictorial sign as follows:

Essentially a means of structuring language so as to produce continuously linked series of double or multiple meanings, this symbolic mode depends largely upon syncretic mixtures of symbols from which it builds up "levels of meaning," sometimes as few as two, or as many as seven. Minimally it holds that no single literal meaning can stand alone, but that a valid utterance must possess a transcendent meaning as well, a symbolic surplus beyond the literal level. Most allegories are images of cosmic order, and their fixed, hierarchical, and timeless character becomes problematic whenever such cosmic orders are subjected to temporal analysis. The key to the permanence of allegory throughout history appears to be its ornamental surface, which allies it with changes in cosmology and decorum and gives it an exploratory as well as a traditional and

conservationist function (Fletcher, 1968: 41).

As Fletcher mentioned, the allegory includes a symbolic surplus which is generated from connecting multiple meanings beyond the meaning of the literal level with the logic outside the words. Moreover, the symbolic surplus transforms itself into the pictorial sign. The linear programming language is designed for correspondence with the outside logic, the CPU. Consequently, the language must be interpreted in its literal meaning in the computer. On the other hand, Smalltalk's information processing with object and message produces a different meanings system from the CPU due to the mechanism of Information hiding. This is writing various notes on the literal meaning indicated by the linear information processing. Furthermore, while the various meanings are tied up with the literal meaning, the linguistic sign forms an allegory which includes a symbolic surplus. In the computer world, this symbolic surplus becomes the icon on the computer display.

However, the icon on the computer display is not released perfectly from the literal meaning of the CPU. As already mentioned several times, it is just hidden by the mechanism of Information hiding in the object-oriented programming language. As a result, the icon does not require the user to interpret the literal meaning like the linear programming language but does require that us read itself based on certain rules. As for the limitations of the allegory, Fletcher points out that "since allegorical works present an aesthetic surface, this implies an authoritative, thematic, "correct" reading, which attempts to eliminate other possible readings. They

deliberately restrict the freedom of the reader. (Fletcher, 1964: 305) " Therefore, the operations possible with the icon are very restricted; "point out" or "move". This shows us that the pictorial sign, the icon, is not essential for the information processing in the computer but just a part of surplus. Even though the icon is a restricted pictorial sign, it has, however, some symbolic meaning beyond the literal meaning, and releases us from having to pursue the literal linear meaning for the CPU.

6. The allegorical relationship between the program and the icon, which the icon hides from the computer display

As mentioned in previous sections, the icon on the computer display and the programming language behind it show us two things. First, the object-oriented programming language hides the process of the CPU's linear information processing in order to give the user other meanings beyond the literal interpretation of the linguistic sign. As a result, it allows that some possibility of allegorical reading and summons the icon which has symbolical meaning to appear in the computer display against the strict logic of CPU. Second, although it is a property of the pictorial sign to escape the limits of a linear reading of words and to prompt a free interpretation, the icon is always limited in its interpretation because it needs the allegorical relationship with the linguistic sign in order to be generated in the computer display. We can reinterpret the computer display as the place where the complementary relationship between the linguistic sign and the pictorial

sign unfolds. However, this complementarity is hidden from the computer display by the icon itself which has an analogical relationship with the real world. Consequently, we begin to believe that it is easy to understand and control the computer with the icon, and as we do not consider what the actually icon is. In this section, we want to examine how and why the icon hides the complementarity relationship between the linguistic sign and the pictorial sign from the computer display.



Figure2. Dipintura, the original frontispiece for Vico's The New Science, 1744 (Fletcher, 1991: 148)

If Vico begins *The New Science* with an engraved frontispiece or "Table," *The Dipintura*, he also at once provides an extended verbal "Explanation of the Picture Placed as Frontispiece to Serve as Introduction of the Work" --- twenty-three pages in the English text. The Explanation shows verbally that the *Dipintura* pictorially *reduces* the twenty-three pages and by extension the whole of *The New Science* to a single complex image. In so doing the *Dipintura* doubles a temporally extended verbal construct, by synchronous emblematic means. Picture schematizes text, apparently without subversion (Fletcher, 1991: 153). [Emphasis is in the original]

This text by Fletcher is highly suggestive for us because he tells us that rather long verbal explanation is reduced to an image while it explains itself. It is a process by which the temporally extended verbal construct, which is always built in a reading act, is compressed into a pictorial sign which has simultaneity. In this process, the meanings of the linguistic sign are disposed in the order of co-existences generated from the pictorial sign. Then, the temporal construction of the linguistic sign hides itself from us and becomes a structure for a spatial construction in order to make and support a new pictorial sign. Therefore, even though the *Dipintura* is useful in helping us understand it more deeply, we should consider that we have to both look at its picture and also read its long explanation in the linguistic sign. Fletcher also asks a question; "Can a poet imagine a sequence that is devoid of the passing of time, when the poem shifts from space to space, point to

point, as long as there are more than two points in the diagram (Fletcher, 1991: 173)?

Because there is a rather long explanation, the indications of the pictorial sign are arranged into a time line again and we can understand it. If there is no such explanation, the meaning of the pictorial sign drifts forever. The reason is that it is a property of the pictorial sign to be interpreted freely. Therefore, we have to demand of the linguistic sign a text in order to fix the meaning of the pictorial sign, although the verbal explanation forces us to interpret itself literally. This means that time hidden by the pictorial sign begins to move again with the linguistic sign which represents logic because "Time and the Logos are, no doubt, violently yoked together (Fletcher, 1991: 174)." As a result, we always end on a note of temporal description whenever we begin to analyze the order of co-existences of the pictorial sign spatially.

Now, we consider the icon from the idea above of Fletcher. As already mentioned, the icon is the pictorial sign which the symbolic surplus generated from the programming language change into. Therefore, the icon on the computer display must be reduced to a linguistic sign which is tightly tied to the time. However, Information hiding, the character of the object-oriented language which is fitted for making the icon, always hides its linguistic part. In other words, Information hiding always hides a part of the linear information processing from us. Due to its structure of Information structure, the icon is always displayed as the object hiding its basic part which is derived from the linguistic sign. Consequently, we can say that the icon on the computer display is an unstable pictorial sign

because the meaning of it isn't fixed by the temporally extended verbal construct. This unstableness opens the icon to free interpretation, which emphasizes only the analogical relationship between the icon and the real world. And more, we just see the icon as a pictorial sign that can be freely interpreted and think that we can easily and freely control the computer with it. As a result, we don't look at the icon as symbolic surplus of the linguistic sign. It means that the allegorical relationship between the icon and the programming language, which restricts the icon's meaning, is made invisible.

## 7. Conclusion

We have considered the property of the icon in the computer display from the viewpoint of the pictorial sign and the linguistic sign. First of all, the icon is the pictorial sign, limited in its interpretation because of its allegorical relationship with the programming language which is restricted by von Neumann logic, the linear information processing. On the other hand, due to its structure of Information structure, the icon can't reduce itself to a linguistic sign in order to fix its meaning and is revealed to us as an unstable object which presses us to interpret it freely. As a result, the allegorical and complementary relationship between the icon, the pictorial sign, and the programming language, the linguistic sign, is made invisible in the computer display. From this study of the icon, we tried to clarify that the icon is symbolic surplus from the linguistic sign and is in allegorical relationship with the programming language. In the future, I hope

to examine the relationship between the user and the icon from the allegorical viewpoint because there is a strong linguistic relationship between the user and the icon and this relationship limits the possibility of the computer interface.

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# The Dynamism of The Alt.elite and The Organizational Change: The use of information technology in an antiquarian booksellers association

Keywords:

alt.elite, identification, legitimatization, information technology, organizational change

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## Abstract

In this paper, we discuss how self-reflective individuals change organizations by using information technology in a conservative booksellers association. Individuals who are information conscious try to change their environments with the transformation of self-identities and the legitimation of selves. We use three key concepts within this study; (1) alt.elites who counter authority with new technologies or skills, (2) identification, which is identity as a process, and (3) legitimatization, which is the dynamic mechanism distinguishing the self from others and authorizing it.

Alt.elites in the association introduced information technology despite meeting with stiff resistance from other members. Through the process of the introduction, the alt.elites have been changing the relationship between the self and others in the internal and external environment of the organization, leading to the legitimatizing the selves in the cultural, economical and management spheres. Finally the alt.elite changed the organization.

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## 1 Introduction

Today, individuals belong to many organizations simultaneously. Furthermore, people who are information conscious try to change their organizations with the transformation of their self-identities and the legitimation of their selves. Nonetheless, only a few studies about information technology in organizations have argued this point.

We are concerned with the case of organization members changing the organization of an antiquarian booksellers association, introducing information systems to the member's customer dealing aspect, with three key concepts; (1) alt.elite (Endo, 1999), (2) identification (Hall, 1996) and (3) legitimatization (Momozuka, after-mentioned).

The organization we analyse, Tokyo-to Kosyoseki Syougyou Kyoudou Kumiai (Tokyo Antiquarian Booksellers Corporative), is a secondhand booksellers' trade association composed mainly of old, established booksellers in downtown areas which trade expensive antiquarian books, and small bookstores which trade secondhand books in local shopping streets. There has been a big environmental change in their traditional business field, because new franchise secondhand bookstore chains have broken into the market. In order to cope with changes in the business environment, alt.elites who were information conscious and tried to change their environment, built an online shopping website and computerized many of the office tasks. The purpose of this paper is to explain such a stratum's attempts to authorize them, distinguishing the self from others continually, by examining actions of

alt.elites in the corporative association.

## 2 The framework

### 2.1 Individuals and Organizations in Modern Societies

Individuals in modern societies are liberated from "Gemeinschaft" (traditionally territorial connections and blood ties). Nowadays, individuals form, join and withdraw from groups of their own free will. An individual belongs to more than one group. According to Simmel (1890= 1980: 487), a man in modern society belongs to his parents' family first, then takes a certain job, and his job itself is built into his many interesting spheres. As a result, individuals belong to a number of groups at the same time, which means people have a sense of multiple belonging. Individuals, therefore, join and withdraw from several organizations of their own free will. In this paper, we use the word "organization" as a group where individuals interact by their own wills.

While belonging to organizations is based on will in modern societies, the "cost" of joining and withdrawing from organization is not necessarily been low. For example, people who work for a Japanese company which chooses the lifetime employment system, or who volunteer in civic activism tend to devote their whole lives to the organization, because it is not very easy to withdraw from it. Nonetheless, Japanese companies have recently promoted early-retirement and begun to employ mid-career workers aggressively, due to the collapse of the lifetime employment system. Furthermore, in voluntarily organizations which have developed recently,

like online organizations, such cost is lower than that in the old associations. <sup>(1)</sup> As a result, the more the cost has decreased, the more organizations individuals have been able to join simultaneously.

According to Weick (1979), organizations are interpretation systems, In other words, an organization makes sense by the reduction in the ambiguity of members, and meaning the organization does not exist from the beginning but is given retrospectively after actions. This brings us to the next point. The question is how we can understand the dynamism between such individuals and organizations.

## 2.2 Alt.elite



Figure 1 The Position of the alt. elite

According to Endo (1999), it is young researchers who have developed the internet; in other words, as groups, they are quasi-elites who have occupied an intermediary position between elites and non-elites. They hold the potential to move up to the level of elites, but they are at a lower-middle position on their social hierarchy. Therefore they counter elites mentally (in fact, are syntonic to non-elites), and find their identities in counter or alternative cultures. As a result, they are suspended in the social hierarchy temporarily.

Endo called them "alt.elites (alternative elites)". (Endo, 1999: 31)

The alt.elite is a diachronic concept; individuals of such alt.elites have countered elites with various advanced technologies or broad knowledge how to cope quickly with the change of the times quickly. In this paper, however, there is only the space to focus on modern alt.elites who counter the hierarchy of authority with new information skills. In this study, an individual's social position consists of two axes; (1) how much skill he has with information technology (information consciousness) and (2) how much she counters the hierarchy of authority. In other words, we divide the society into three segments; (1) the alt.elite strata are the ones which counters the hierarchy of authority with new information skills, (2) the elite strata are the ones at a high level on the hierarchy regardless of their information skills, and (3) the non-elite strata are the ones at a lower-than-middle position on their social hierarchy, without the information skills. (Figure 1)

The alt.elites have both horizontal and vertical relationships with others. The former is the relationship with others based on so-called "networks"; without any consideration of hierarchy levels. According to "The National Survey of Social Stratification and Social Mobility" in 1995, the alt.elites tended to attach a high value to "social activities" and "group activities"; on "the horizontal connection to others". (Endo, 2000: 119, 123)

The latter, on the other hand, is the relationship with others based on achievement; what he or she assigns high value to and achieves in the society. Endo (2000, 2002) claims the alt.elites do not attach

high value to social status, the assets, career and educational qualifications which are valued in the society. As a result, this survey supports two characteristics in the alt.elite's attitude to others.

Additionally, we must emphasize that the concept of alt.elite is not static but dynamic. An individual who is in an alt.elite doesn't necessarily remain in the stratum. Some will join elites, some will remain in the alt.elite position, and some will join non-elites. Furthermore, some people shift to alt.elite strata from the elite or non-elite strata. In other words, to be part of an alt.elite is not a static personal attribute, but one that changes with time. <sup>(2)</sup>

### 2.3 Identification of Alt.elites

The dynamism of alt.elites as described above means individual identity changes continually. According to Imada (1986), action means playing by the rules and accomplishing one's aims and thinking about the significance of the process. In this study, we call such action self-reflective. Furthermore, self-reflective action means differentiation from established meaning, and assigning new meaning by changing the rules. (Imada, 1986: 270- 275)

The self-reflective process is always in progress. According to Hall (1996), the difference between the self and others is not static. Hall (1996: 2) claims identification is a construction or a process never completed; in other words, is always "in process". That means the rule of distinction between the self and others is always changing.

Furthermore, there is not necessarily an anaphoric relation between the elements of

self and others, but the relation is produced. (Hall, 1996; Sterne, 1999) As a result, the differentiation is created by two mechanisms; some parts of the self become those of the others and some parts of the others become those of the self, with the rules modified. Therefore, the production of oppositions is due to the differentiation between the self and others, and the dissolution of oppositions is due to the integration of the self and others. In this paper, we call the former "segmentation" and the latter "articulation".

For this reason, it is claimed that the self is not static and the distinction between the self and the others changed constantly (the rules have been modified). The self repeats the segmentation and articulation process, with the two alternating continually. That is identification. (Figure 2) The self of alt.elite does not exist as a fixed entity but modifies constantly through interaction with others. <sup>(3)</sup>

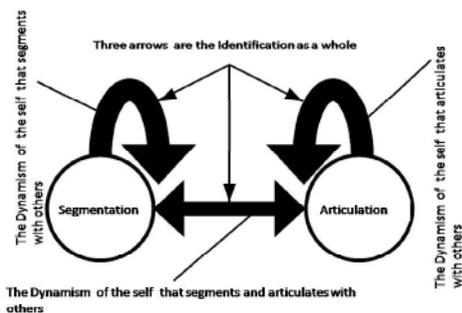


Figure 2 Identification of segmentation and articulation

### 2.4 Alt.elite and Legitimatization

The alt.elites have a vertical relationship with others, which is the dynamism of legitimating the sense of self to others continually. According to Bourdieu (Bourdieu, 1979 = 1984), people who belong to a class or a group have specific ways of acting and

perceiving (*habitus*). Although an individual's *habitus* is consistently distinct from that of other classes or groups, this distinction is not only the difference between the self and the others, but the difference is also an aspect that is valued. Bourdieu (1979= 1984) calls such a difference distinction, and it is thought that distinctive classes or groups have legitimacy in the society.

We can apply Bourdieu's *habitus* to alt.elites' actions. First, there is a difference between alt.elites and elites, in that alt.elites exist at a lower-than-middle position on their social hierarchy. Because elites are legitimate and distinct from alt.elites, alt.elites try to gain legitimacy with elites by action which is countering the hierarchy of authority, characteristic of alt.elites. The elite strata, on the other hand, need not legitimate themselves unless their legitimacy becomes weakened. (Ishii, 1993: 196)

Bourdieu argues that the legitimacy of cultures in rather static class societies exists with a few exceptions, and that it no longer prevails with the upward mobility of people. <sup>(4)</sup> Bourdieu adds that legitimacy of culture tends to continue after it is established, but that the legitimacy the alt.elites gain does not always continue, in other words, they do not legitimate though they try continually to establish it. In this paper, we call the effort to gain legitimacy by alt.elites "legitimatization". In other words, the vertical relationship alt.elites have with others is the dynamic mechanism of legitimatization to be distinct themselves from others. <sup>(5)</sup>

## 2.5 The dynamism of alt.elites

As mentioned above, the alt.elite strata in

this study counter the existing social hierarchy, and try to change their society with information technology, building both horizontal and vertical relationships with others. Additionally, such individuals have identification through segmentation and articulation with others, thus legitimating themselves, and making themselves distinct from others. In other words, alt.elites try to authorize themselves, building relationships with others constantly.

In this paper, using this framework, we examine a case whereby alt.elites who were information conscious and had both horizontal and vertical relationships with others tried to legitimate themselves in an antiquarian booksellers association and finally changed the organization by introducing computer systems. We also examine the dynamism alt.elites caused in the association. <sup>(6)</sup>

## 3 The Case

### 3.1 The Antiquarian Books industry in Japan

The antiquarian book industry in Japan is divided into two groups. One consists of traditional and old-style secondhand booksellers which are affiliated with antiquarian booksellers in each prefecture, that are subordinate organizations, in a sense, of Zenkoku Kosyoseki-syou Kumiai Rengou-kai (Zen-Kosyo-Ren: The Antiquarian Booksellers Corporative of Japan)). Many of these bookstores are small and long-standing but show deteriorating sales (Tokyo-to Kosyoseki Syougyou Kyoudou Kumiai, 1996). The other consists of new franchise secondhand bookstores, aggressively expanding business, whose stores located mainly in suburban areas

are large, and managed by manuals and POS systems like fast-food franchises stores. (Oda, 2000)

The antiquarian bookseller association is traditional storemembers belong to a cooperative association (Jigyou Kyoudou-kumiai), which is "horizontal organization consisting of small business traders in the same trade who communicate and collaborate with each other by participating in many projects" <sup>(7)</sup>. For example, according to the Tokyo Antiquarian Booksellers Corporative (TABC) clause, the object of the association is "based on the spirit of helping one another, by forming joint projects necessary for its members, to promote self-motivating business activities of members, to improve members' economic position, contribute to the flourishing of domestic and international cultures, and to intermediate the antiquarian books markets successfully" (Articles of TABC, chapter 1). In other words, the role of antiquarian books associations is to foster communication among the members in order to trade antiquarian books on the members' markets.

### 3.2 The challenge of introducing computers by TABC

Since the 1990s, due to slow sales, many of the secondhand booksellers that belong to the associations have been put in a difficult position, and the franchise large stores, as mentioned above, have invaded the market all over Japan. There were some people in TABC who had a sense of crisis about the situation. They researched their environment and prepared a report, "The Research Report to find a vision of survival; present and future "

(Tokyo-to Kosyoseki Syougyou Kyoudou Kumiai, 1996). In this report, they claimed that one of the roles expected of TABC would be to introduce computers.

In 1996, many of TABC's members "had a vague sense of fear about computers, because they thought that computers would replace books" <sup>(8)</sup>. The report said "the information age has already come to Japan. Although the antiquarian books industry has had from its origins the aspect of being an information-distribution industry, we have not made an effort to carry this idea forward. With the coming of the multimedia era, we should be examining what we can do for the industry, if antiquarian books as a media can survive in the future," (Tokyo-to Kosyoseki Syougyou Kyoudou Kumiai, 1996: 6). The report said, moreover, that the Internet was useful in the information age, and to make a portal site on the internet about antiquarian books edited by the association would result in improvement of convenience for its members and customers. In September 1996, based on the above claim, the association formed Internet Un'ei Iinkai, a steering committee to experiment on how the internet could be used. In September 1996, in addition, two committee members who had advanced computer skills led other TABC's members in opening the website "Nippon No Huruho-ya (Japanese secondhand booksellers)" where more than 50 voluntary members sold used books.

All association members, however, did not support the committee, and committee members had a hard time getting other members to accept them, because many TABC's members didn't know what kind of

organization the committee was or where the committee belonged. (Zenkosyoren News, 2000.7: 8) Some members criticized the committee for introducing the internet without permission of TABC, because only a small number of members joined the website.

Many objections against the operation policy of the committee were sent to TABC one after another; against the policy of using the internet in TABC (in some cases because the skills were lacking; in other cases, despite an understanding of the internet.) Someone who was against the internet claimed that only 30 % of the members could use the internet and the committee should have understood that. Someone claimed that it was an immoral affront to customers and self-defeating for antiquarian booksellers to use the internet disclose knowledge that could be read by the general public about antiquarian books accumulated by booksellers over a long period of time. (Kosyo Geppou, 1997. 8)

Additionally, someone criticized the committee itself and wrote to say that the TABC must not have operated a private profit-making business that each member managed. Someone had opened a commercial website for himself because the association did not have the technical skills sufficient to run such a website. (Kosyo Geppou, 1997. 8)

In spite of a number of such complaints against the internet, the amount of sales on the website had been increased steadily. As sales accelerated, objections against the committee decreased, and the number of members using books on the website increased. Some booksellers tried to increase online sales more aggressively than the committee intended. Finally, the number of

booksellers selling antiquarian books on the website raised rapidly from only a small number of people when it began in 1996 to more than 450 all over Japan by April 2002.

#### 4 Analysis of the case

##### 4.1 The position of alt.elite in TABC

The organizational change in TABC was carried out, counter to existing authority, by the alt.elite strata with information skills. We analyze, first, the position of alt.elites in TABC.

When the association began to use the internet in 1996, it was divided into 4 strata according to hierarchy and degree of information consciousness in TABC.

- (1) Information conscious establishments: these strata are capable of introducing information technologies independently. Thus they don't run into contradiction with the conventional values of TABC, because they don't expect the association to introduce a computerized information system.
- (2) Conventional establishments: these strata are satisfied with current business without use of the internet, so they do not contradict the conventional values of TABC.
- (3) Conventional tiny stores: although these strata feel dissatisfied with their situation, they are negative about using computers, so do not contradict the conventional values of TABC.
- (4) Information conscious reformers: these strata feel dissatisfied with their situation, expect TABC to introduce technology, and

so contradict the conventional values of TABC.

Information conscious reformers are the strata that changed conventional values in TABC with the introduction of the internet despite the anti-reformation feeling about the internet that raised. In other words, they countered existing authority by using information technology, thus displaying a key characteristic of alt.elites and thereby became the alt.elites in TABC. (Figure 3).

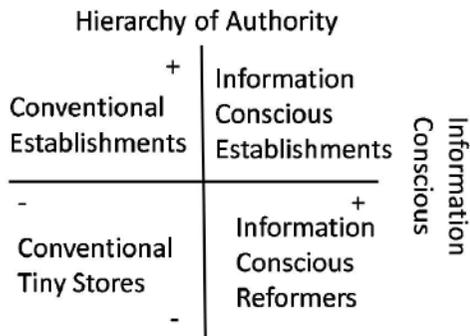


Figure 3 The Position of the alt. elite in TABC

4. 2 The segmentation and articulation of alt.elites  
The alt.elites in TABC segmented and articulated, both in the overall organization and within member organizations.

4.2.1 An example of the segmentation within TABC (1)

First, alt.elites in TABC segmented from conventional establishments and tiny stores (two information unconscious strata). The strata that weren't information conscious and hoped to continue traditional business practices, were afraid that by selling books on the website, and by publicizing tacit knowledge about the antiquarian books members had, the price of secondhand books

would converge into one price, but alt.elite strata claimed that it was useful to compile a database of knowledge about booksellers' antiquarian books. (Kosyo Geppou, 1998.8: 15) This means there is the production of opposition between two information unconscious strata and alt.elite strata; the former intended traditional business by the seat of their pants, and the latter intended to verbalize tacit knowledge about antiquarian books members had. <sup>(10)</sup>

4.2.2 An example of the segmentation within the association (2)

Secondly, alt.elites in TABC segmented from information conscious establishments. Each bookseller of this establishment introduced information technology on their own at that time and alt.elites didn't try to make them join the website. However alt.elites did encourage other members to join who did not have sufficient information skills to use computers and the internet by themselves. (Kono, 1999) Alt.elites organized workshops to support these unskilled members, and used a customized windows PC at the TABC office to recommend to TABC members what kind of computer they should buy to use the internet. Members could buy the machine at the office immediately. (Kosho Geppou, 1997. 12: 4) This process demonstrated a conflict between information conscious establishments who intended to computerize separately and alt.elite strata who intended to computerize together.

4.2.3 An example of the negotiations within the association

Thirdly, alt.elites in TABC negotiated with

the information conscious establishments. As described above, the committee first opened the website for beginner internet users and supported them. In 1999, each user could register book data in the database directly, with the website renewed by the organization and the user interface altered. After the renewal, TABC appealed to the advanced internet users to join the site. (Kosho Geppou, 1999. 8) This led to a resolution of the conflict between the informational conscious establishments and alt.elites.

#### 4.2.4 An example of the negotiations outside the association

Fourthly, alt.elites in TABC negotiated with an external organization. The committee released members to open a shop on other websites managed by private antiquarian book companies; in particular the website, M Inc., established in 1995, which targeted the same market as the association's site. There was a strong probability, as some members feared, that both sites would compete with each other. Nonetheless, alt.elites in the organization allowed the users to open stores on the M. Inc's site. (Zen Kosyoren News, 2000. 7: 9) This led to an end of conflict between the association and external organizations.

#### 4.2.5 An example of segmentation with an external organization

Finally, alt.elites in TABC segmented with an external organization. They set the goal of "making the website number-one in the antiquarian books industry" <sup>(11)</sup>. M. Inc, however, had already opened an antiquarian book shopping-mall on the internet before

TABC built the website, and claimed that it was the leading information technology-related company in the industry. This claim was possible because an encyclopedia of current events and words had listed the enterprise as the first in Japan to open an antiquarian bookstore mall on the internet. <sup>(12)</sup> On the other hand, alt.elites in TABC, setting a goal to make the website most excellent in the industry of Japan, segmented with the internal and external organization.

As a result, alt.elites in TABC developed a clear and dynamic identity, through segmentation and articulation within the internal and external organization.

#### 4.3 Legitimatization of the alt.elites in TABC

As mentioned above, alt.elites have a vertical relationship with others. Such actions are recognized in the alt.elites of TABC.

They thought that even if antiquarian booksellers that belonged to the associations had been "old-fashioned" and in a "minority", they had been "the standard in the industry". In addition, they claimed that if they solidarized each other, they would be able to "create the largest 'antiquarian book space' on the internet", because such booksellers were a "professional group" in which each bookseller specialized in a certain genre. (Kosyo Geppou, 1999. 4: 26). They projected to authorize their website as distinct from others that dealt with secondhand books. (Momozuka, 2002) This means that the alt.elites in TABC engaged in a vertical relationship with others.

It can be argued, therefore, that why making the largest antiquarian books space means legitimatization. Three different vertical relationships among alt.elites and others were

observed.

First, the alt.elites in TABC had a vertical relationship with others from the cultural aspect. Some alt.elites, as described above, claimed to compile a knowledge database about "the one thousand-year-history of antiquarian books" (Kosho Geppou, 1998. 8) that the booksellers had uniquely. This means that they tried to authorize themselves as distinct from others by drawing attention to the cultural aspect of antiquarian books.

Secondly, they created a vertical relationship with others from the economic aspect. Some alt.eites were interested in the quantity of books sold on the website after the site had opened. This means distinguishing themselves from others by focusing on the material aspect, and expanding the scale of operation to pursue greater profits. <sup>(13)</sup>

Finally, they engaged in a vertical relationship with others from the managerial point of view. Some of them inspired by the introduction of the internet in TABC tried to modernize the TABC's management. They thought that using information technology would lead to reviewing management methods themselves. This means distinguishing themselves from others through innovation of the management style. <sup>(14)</sup>

As a result, it is revealed that vertical relationships between alt.elite in the organization and others have multiple dimensions. The alt.elites legitimized themselves simultaneously in cultural, economic and managerial aspects of the operation to counter existing authority with information technology.

## 5 Conclusion and future research

These results lead to the conclusion that the volunteer members in TABC changed existing order in the organization by introducing information technology and forming a website for customers dynamically. It is argued that they were alt.elites who countered existing authority with information technology. First, The alt.elites in the association segmented and articulated with internal and external organizations at the same time. Secondly, they tried to legitimate themselves by making themselves distinct from others in term of cultural, economic and managerial aspects. Finally, the organization changed dynamically on the whole through this transformation in the relationship between the self and others as a result the merging of such actions.

Our results have several implications, not only for antiquarian booksellers associations, but other cultural industries as well that deal with cultural goods or services, especially organizations in "the reading space" (Nagamine, 2001) where individuals communicate with each other about books. <sup>(15)</sup> Because these organizations are facing similar problems under similar circumstances to antiquarian booksellers associations. For instance, in publishing companies, it is pointed out that stores selling newly-published books and corporative associations, which belong to traditional industries that deal with culture, are slow to computerize despite the difficult environment and depressed book sales. It can be argued that alt.elites produced in such organizations could change their situation with information technology.

Future research should analyze the relationship between the organizations alt.elites belong to and external organizations. Alt.elites, however, are not affiliated with only one organization, and we have not discussed the dynamism of alt.elites fully from the point of view of the relationship between one system and another system. First, due to the focus being mainly on the alt.elites in the internal antiquarian booksellers' organization, such alt.elites have not been located in the reading space. As we mentioned above, secondhand bookstores and antiquarian booksellers associations are in the reading space as publishing companies and stores selling new books. Further research is needed on the dynamism of such alt.elites in the reading space. Secondly, we have to discuss the link among each of the three vertical relationships and others. The legitimatization of alt.elites can be multilayered, and the managerial legitimacy can be the means to pursuing the end of other legitimacies. As a whole, alt.elites may seek to legitimize themselves in a multilayered way. Such possibilities must be explored in the future.

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#### Footnotes

(1) For example, according to Endo (1999), internet activism does not have characteristics such as tight organizing, total personal commitment and

physical involvement.

- (2) Due to the alt.elite as a dynamic concept, there is not a static group of alt.elites. However, when observers focus on an organization at a given moment, alt.elites look like a cluster or a stratum. For this reason, we use the phrase the alt.elite strata, to indicate of more than two alt.elites at one particular moment.
- (3) The segmentation and articulation of identification between the self and others are, in other words, the condition of similarities and differences between the self and others. It is obvious that such a difference relates to joining or countering the social hierarchy, but in this paper, we make the assumption that the difference between the self and others is arbitrary. It is not until the difference is positioned in the society, that it becomes an issue of the distinction of either the self or others.
- (4) The sale of letters of the nobility in the English aristocracy provoked devaluation of these titles. As a result, the existing title holders introduced differences such as manner to devalue the newcomers in their society. ( Bourdieu, 1979 = 1984 : 161)
- (5) In this Study, after alt.elites complete authorizing themselves and don't have the motivation for authorizing, they shift to elites.
- (6) For further details of the case, see Hanaoka and Momozuka (2000).
- (7) See, in particular, Miyashita(1999: i).
- (8) This is the view of Mr. Takayuki Kono the former manager of public relations, Tokyo Antiquarian Booksellers Corporative. Mr. Kono and Mr. Toshio Hanai, the manager of public relations at that time were interviewed about introducing computer technology and the internet in TABC on December 27, 2001.

- (9) They had the most advanced skills about computer technology skills amongst antiquarian booksellers. For example, they published antiquarian books catalogs using computers and established a computer-based inventory control and customer management systems. In addition, one of them wrote computer programs of the antiquarian books management systems to sell to other booksellers, and one of them introduced a minicomputer and database system and built the LAN in the company and connected the network to customers' computers. (Yamaoka, et.al, 1996: 170- 188)
- (10) This notion about the knowledge-based database system that alt.elites described; is similar to the conversion of tacit to explicit knowledge. (Nonaka & Takeuchi, 1995= 1996)
- (11) Takayuki Kono, December 27, 2001. See n. 8.
- (12) For further details of the case, see Jiyu Kokuminsha (2002: 1237), the item name, "Kosho Net Tuuhan".
- (13) This strata's way of thinking about management is thought to be similar to the management methods of the franchise chain secondhand bookstores, Sin-huruhon'ya. According to the report, there were members in TABC who tried to expand the scale of operation in 1996. (Tokyo to Kosyoseki Syougyou Kyoudoukumiai, 1996: 42- 46)
- (14) Toshio Hanai, December 27, 2001. See n. 8. According to Mr. Hanai, one of the important problems members had was that they did not manage the book catalog on the website properly, because they were not able to control the inventory management in their bookstores.
- (15) Nagamine (2001) calls the set of elements that constitute people's reading lives, "the reading space ". According to Nagamine, the following three elements constitute the reading space: (1)

the development of printed media like newly-books, antiquarian books and magazines, (2) various distribution channels to disseminate them like newly-book stores, antiquarian bookstores, and libraries, (3) the media receptive capability of various readers like white-collared workers and blue-collared workers. The reading space is constituted with a relationship among an elements.

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# Socio-Cultural Differences in the Use of Personal Web Homepage and Electronic Communities among Japanese, Finnish, and Korean Youth

Keywords:

Having homepages, Cross-cultural comparison, Anonymous ties, Korea, Finland

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## Abstract

Statistics about the young in Japan, Finland, and Korea show that only a small percentage of people have a personal web homepage. What are the differences between homepage holders and others? We attempt to answer this question by examining empirical data and focusing on information-network environmental factors and individual factors. Results show that in the three countries, people who have higher Internet skills and motivation to communicate with others are more likely to have homepages. However, in terms of Japan alone, statistics show that those who have a homepage tend to use it at home and tend to use the Internet to reduce psychological stress (for "healing"). The Japanese characteristics may reflect the fact that those who have homepages are often engaged in anonymous communication on websites (e.g., personal diaries) alone at home, which is hardly observed in other societies.

## 1. Introduction

There are a variety of Internet functions and applications, one of which is a web-homepage. Through a homepage (HP, hereafter) one can send information to anyone in the world, and it differs from mass media since there is little legal certification or regulation relevant with use of it, and it does not require large-scale resources. Therefore, it may be possible for anyone in society to make use of HP to express themselves.

However, although the number of Internet users and the amount of information carried on HPs are increasing, many people do not actually have personal HPs. Table 1 shows the percentages of those who have HPs among undergraduate students in Japan, Finland and Korea. Although undergraduate students are usually active in using new technologies, there are only a limited number of people who have their own HPs.

We question why everyone does not have a HP, although it is assumed that everyone can utilize them. What distinguishes those who have HPs from others?

Table.1 Percentages of Those Who Have HPs among Undergraduates

HP	Japan (N=353)	Finland (N=242)	Korea (N=420)
Have	13%	17%	28%
Not	87%	83%	72%

Note: The data were collected in Japan and Korea in 2002 and in Finland in 2003 (details below).

The present study examines environmental factors (mainly information networks) and individual factors, some factors that may

distinguish various kinds of HP holders. We also point out differences between Japan, Finland and Korea through comparative analyses. By doing so, we can see the characteristics of each society. Such a comparison will also show similarities among the societies, which are considered to be "media characteristics" of HPs.

In this study we conduct quantitative analyses by employing empirical data. Targets are undergraduate students in Japan, Finland and Korea.

Before the main discussion, it is important to make some brief statements about the Internet phenomena in each society. Japan, Finland and Korea have been at the forefront of technical development of the Internet and mobile communication devices in the world ("IT development in 90's" [Kimura, 2004]).

Finland is one of the Northern European countries and has the world largest cellular phone company, NOKIA. Northern Europe is a leading area of IT development and achieves the highest ratio of diffusion of the Internet and cellular phones in the world, which is almost the same in actual figures as the U.S. (Steinbock 2001, Kimura 2004, Yamada 2006)

In Korea, diffusion of the Internet did not begin as early as in other leading countries, but the Internet on broadband (BB, hereafter) such as ADSL has diffused rapidly. It was not until the late 2000s when the government started establishing active IT policies. In December 2002, the ratio of Internet users was 59.4%, among whom DSL users were 83.9% and cable modem users was 12.8%. Then, Korea came to be known as the "broadband society" using the highest level of this technology in the world (Korea Network

Information Center 2003). From 1998 to 2000, "PC Bans" (internet cafes providing a high-speed but inexpensive Internet service) spread, which was earlier than the diffusion of BB at home. The cafes became popular especially among young people (Iizuka 2000, Kure 2002).

Japanese society leads in terms of the Internet, camera mobile phones, and other digital devices (e.g., digital cameras). BB in Japan is almost the cheapest in the world, and the ratio of BB users is the second highest in the world, following Korea.

Therefore, it is valuable to compare these three societies from the viewpoint of information-communication studies.

## 2 .Literature Review

One of the important approaches in the previous studies is the use of "mass society theory," which developed with the innovation of mass media (Riesman 1953; Mills 1956). According to this theory, individuals are becoming alienated in society because "middle groups" (e.g., family, local community) are collapsing these days, and individuals are only passive receivers of information sent by mass media (e.g., TV, newspaper).

However, nowadays, the means of sending information are becoming more and more accessible to individuals because of recent new media, especially the Internet. Anyone can send information cheaply through the Internet, and s/he does not need large-scale equipment (Tsuji 1997, Miyata 1998). Mass society theory is not necessarily applicable yet, because individuals are not so passive.

The Internet now provides new

communication styles that old media did not. For instance, email, BBS and newsgroup enable us to communicate with others without having to concern ourselves with time and the convenience of the receiver. Previous studies about such new communication styles include Kim (2004), who examined communication skills and BBS participation, and Ohata (2001), who examined the relationship between BBS participation and social network in the real world.

Among the studies on HPs is Miyata (1998), who shows that individuals' motivation is one of the factors distinguishing HP holders and others. Kawaura (1999) examines why individuals write personal diaries on HPs, and provides some reasons in these quotes: "I can maintain it easily", "I'd like to express myself" and "People around me have it, too."

A similarity among these previous studies is that no comparison between HP holders and others is attempted. They tend to focus on HP holders, rather than looking at both groups. Therefore these studies hardly clarify the differences between HP holders and others. While Okamoto (2001) and Yamamoto (2003) do actually compare those two groups, they examine the offices of political candidates, to learn why some have HPs while others do not. They cite the important role of candidates' educational levels and so on. Also, they examine the organizational or business aspects of HPs, rather than individual aspects unlike our study.

This present study attempts to compare HP holders with non-users in Japan, Finland and Korea. We hope to draw attention as well to valuable findings about similarities and differences amongst the three societies in

terms of their HP holders.

### 3. Our Interests

Table 1 shows that everyone does not have HPs, even though it is assumed that anyone can utilize HPs. So, what promotes or inhibits the use of HPs amongst individuals? Do people have HPs if the appropriate physical environment is provided? Or, are individual aspects more important? We consider these questions by looking at environmental and individual factors.

BB equipment seems to play an important role as an environmental factor. BB can carry much more information at a time than narrow bands (e.g., telephone lines). These days, we use BB in many places such as the workplace, school, and home. It is easily speculated that environments equipped with BB would be more appropriate for the use of HPs.

Another environmental factor is places where people use the Internet. Although we can now use the Internet at school and internet cafes as well as at home (Mima 1999), people seem to feel more comfortable managing HPs at home to.

In addition, there are various individual factors. The first one is technical skill in the use of the Internet. Usage of the Internet requires the skill to deal with a lot of information and to utilize many computer functions. In fact, a research study (Cho 2000) shows that one of the reasons why people do not use the Internet is they do not know how to use it.

The second individual factor is the level of concern people have about security on the Internet. People may be reluctant to have HPs

if they are very afraid that personal revelation via HPs might involve in problems (c.f., Hashimoto 2003, Yamamoto 2000).

However, there are people who live in BB-equipped environments, have high technical skill, are not afraid of possible problems, yet do not have a HP. Therefore we need to consider people's purposes in using HPs, to help distinguish HP holders from others.

One of the purposes in the use of the Internet is communication with others, or to express oneself. People consider the Internet a useful media to send information and to express themselves. A study (Kawaura 1999) argues that those who have HPs for this reason tend to be active in communication.

Another purpose is to reduce psychological stress and the loneliness that people feel in daily life. A study (Kawaura 1999: 137) shows that use of HPs to express oneself is positively related to healing such feelings. Other purposes include gaining easy access to useful news, information, and entertainment, which are also analyzed below.

### 4. Data

This study employs the data of undergraduate students on their use of and attitude toward the Internet in Japan, Finland and Korea. In December 2002, we conducted our survey of students at private universities in Tokyo, Japan, and Seoul, Korea. Questionnaires were distributed and collected mostly in class. The numbers of respondents were 487 in Japan and 490 in Korea. The survey was managed by Yoshiaki Hashimoto and his colleagues in the University of Tokyo (see more details in Hashimoto et al., 2003).

As for Finland the data were collected in 2003. The questionnaires were distributed amongst undergraduate students of University of Helsinki. The number of respondents was 315.

We believe there are some strengths in using such data. First, since all the respondents were undergraduate students, we could control for educational levels and occupations, and ages within a minimum range. Second, since undergraduate students hardly use HPs for business, we could assume their purposes in using HPs to be personal. Third, percentages of those who used the Internet were very high in our data (95% in Japan, 99% in Finland, and 97% in Korea), so we can assume that almost all the respondents were the Internet users, and that our data excluded the Internet nonusers. Thus, we could almost examine more precisely what distinguishes HP holders from others among Internet users.

### 5. Variables

Table 2 exhibits descriptive statistics of variables used in the analyses below. Interpretation of the descriptive statistics is not the main aim in this study, so in this section we provide only brief explanations of some variables relevant to the discussion that follows.

A dependent variable in this study is "having a HP (=1)" or not (=0).

Explanatory variables including "BB at home," which is measured by "yes" (=1) or "no" (=0). Table 2 show that in Korea the percentage of those who have HPs is relatively high (standard deviation is low). In Korea, the

Internet by dialup has not spread so much, but the Internet by ADSL is defused widely. Thus, it seems that BB at home is used by default there.

Table 2 Descriptive Statistics

	Have HP	Information Environment		Individuals	
		BB at home	Where they use it	Skills	Afraid
Japan (N=353)	.13 (.337)	.55 (.498)	.87 (.334)	7.47 (2.160)	19.19 (4.525)
Finland (N=242)	.17 (.376)	.63 (.484)	.79 (.412)	8.51 (2.276)	15.35 (4.433)
Korea (N=420)	.28 (.448)	.95 (.213)	.86 (.348)	9.20 (1.863)	19.35 (4.308)
Range	0-1	0-1	0-1	3-12	5-25

Table 2 (continued)

	Individuals (Purposes)			
	Communication	Healing	Collect in-form ation	Entertainment
Japan (N=353)	11.12 (3.966)	9.97 (3.107)	12.24 (2.720)	8.72 (2.348)
Finland (N=242)	11.46 (4.163)	9.49 (2.930)	12.15 (2.468)	6.33 (2.222)
Korea (N=420)	16.78 (4.566)	12.11 (3.199)	13.07 (2.286)	8.83 (2.036)
Range	7-28	5-20	4-16	3-12

Note: We include only cases that answered all the relevant questions. Values in ( ) refer to standard deviations.

Another environmental factor is "where they use the Internet ": at home (=1) or other places such as university campus and internet café (=0). In our survey, we categorized four places: home, school, internet café, and others, and the respondents were asked what percentage of their time they spent in using the Internet at each place. Those who answered more than 50% at home are defined as "1," others as "0." Table 2 shows that the percentages are relatively higher in Japan and Korea, compared with Finland.

In addition to environmental factors, there are various individual factors. Among them is "Internet skills," referring to technical skills to make use of the Internet, which we measure by a sum of three items: "I can find necessary information by using search engines, " "It is easy for me to download software from websites," and "People say I know a lot about computers." Each of these three has a four-category scale, and higher scores mean higher skills. Table 2 shows that the score in Japan is a little lower than those of the other two societies.

Another individual factor is "afraid of the Internet." This variable measures how seriously people are afraid of the Internet, by using a sum of five items: "I'm afraid that somebody can know which websites I looked at and who I communicated with by email, " "Personal information such as my name, address and credit card number may be released," "Computer viruses may intrude into my computer," "Information on my computer may be stolen," and "Somebody may steal my login password and use my computer without permission." Each of the items has a five-category scale, and the higher their scores the more afraid people are. Table 2 shows that people in Finland are relatively less afraid, partially because they use the Internet much more for business (Kimura 2004). Actually, it is very common for Finnish people to give and take their email addresses through the Internet even between people who have not met. Also it is not strange to inform somebody else of their colleagues ', friends ', and acquaintances' names. In contrast, the Japanese are as afraid of the Internet as the Koreans at higher level. This is reflected in

Inoue's (2001) and Kure's (2002) findings, that people in Japan and Korea use the Internet for entertainment and for chances to meet people.

Another factor distinguishing HP holders from others is people's purposes in using the Internet. They are measured by 19 items, each of which is measured by a 4-point scale. Factor analysis summarizes these items into 4 indices: "communication," "healing," "collecting information," and "entertainment." The items of each index are described in Table 3.

Table 3 Indices of "Purpose to use the Internet"

Index	Items
Communication	Get topics to talk to others, Seek chances to meet people, Strengthen relationships with those who I already know, Enjoy group activities with those who share the same hobbies and interests as me, Express my feelings, Inform people of my thoughts, Inform people of my existence (7 items)
Healing	Spend extra time, Reduce loneliness, Feel comfortable, Escape from troubles, Do it everyday (5 items)
Collect Information	Search for information, Get more knowledge, Getting to know news, Gain new ideas (4 items)
Entertainment	Enjoy entertainment, Get stimulated, Have fun (3 items)

The first index is "communication," referring to the exchanging of information and opinions, and the expressing of their personal thoughts and feelings on the Internet. Table 2 shows that it is relatively higher in Korea.

The second index "healing" refers to the releasing of psychological stress and escaping from troubles, indicated as "loneliness" and "comfort" in questionnaires. This is also the highest in Korea.

The third index is called "collect information," referring to usage of the Internet for the purpose of gaining necessary information. There is not a large difference among the three societies, but it is a little higher in Korea.

The fourth index is the usage for "entertainment," which is indicated as

"stimulation" and "joy." This is almost at the same level in Japan and Korea, and a little lower in Finland.

## 6. Results

In this section, we will show similar and different characteristics in the three countries. An analytical method used in this study is a test of significant difference (t-test). Results are shown in Table 4.

Table 4 Having HPs and Explanatory Variables

	HP	Information Environment		Individuals	
		BB at home	Where they use it	Skills	Afraid
Japan (N=353)	Have	.76**	.96	9.65***	19.3
	Not	.52	.86	7.14	19.2
Finland (N=242)	Have	.76	.76	9.90*	14.2
	Not	.60	.79	8.22	15.6
Korea (N=420)	Have	.93	.82	9.75*	19.7
	Not	.96	.88	8.99	19.2
Range		0-1	0-1	3-12	5-25

Table 4 (continued)

	HP	Individuals (Purposes)			
		Communication	Healing	Collect Information	Entertainment
Japan (N=353)	Have	15.0***	11.9***	13.7***	10.1***
	Not	10.5	9.7	12.0	8.5
Finland (N=242)	Have	13.8***	10.3	12.3	7.0*
	Not	11.0	9.3	12.1	6.2
Korea (N=420)	Have	17.7*	12.2	13.1	8.9
	Not	16.5	12.1	13.1	8.8
Range		7-28	5-20	4-16	3-12

Notes: \*P<.05, \*\*P<.01, \*\*\*P<.001.

The first factor in the category of information environment, "BB at home," shows no significant difference in Korea, but a significant difference in Japan and Finland, (P< .10).

The second factor, "where they use it" shows no significant difference in Finland and

Korea in Table 4. However in Japan, the Internet tends to be used at home (P<.10).

The next group of factors concerns with individual characteristics. The first one is "skills" in use of the Internet. In Table 4, this explanatory variable seems to play an important role, meaning that those who have higher skills are more likely to have HPs. This is the case in all three countries.

Another individual factor is whether people are "afraid" of the Internet. We do not see significant differences in Japan or Korea, but there is a difference in Finland (P<.10), meaning that those who are strongly afraid tend not to have HPs.

Another individual factor concerns the purposes in using the Internet, measured by four indices. The first index is "communication." Table 4 shows that those who like to communicate with others tend to have HPs. They are considered to use the Internet for social purposes rather than personal purposes. In this respect, we do not see differences among the three societies.

About another factor, "healing," we find that Internet users rather than others are more likely to have HPs in Japan, but we do not see this in Finland or Korea.

Another factor, "collect information", shows a significant difference only in Japan. This means that those who use the Internet for the purpose of collecting information are more likely to have HPs. This is not observed in Finland or Korea.

The last factor "entertainment" exhibits significant differences in Japan and Finland. In contrast, we do not see a similar tendency in Korea.

## 7. Discussion

Summarizing the findings above, higher skills in the use of the Internet, and the use of the Internet to communicate with others, both play an important role. These findings are observed in all three societies, so these may be distinct characteristics of a HP as a medium.

In other aspects we see some cultural and societal differences. First, concerning "BB at home," because almost all the households already have BB in Korea, statistical differences may not appear. But in Japan and Finland, BB at home seems related to having HPs. However, we should consider that in these two societies, there may be the other factors (e.g., degree of use of the Internet) relating both with BB at home and with having HPs. Furthermore, it is possible that if BB spreads as widely in Japan and Finland as in Korea, BB at home may not explain why people have HPs. In any case, the results show that BB at home may promote them to have BB, but lack of it doesn't seem to discourage them.

Another individual factor, "afraid," is not significantly related to having HPs, which means that people's concerns about computer viruses and crimes do not matter. There is plenty of media discourse about Internet problems in Japan and Korea (Yamamoto 2000, Hashimoto 2003), and so it is possible that many people afraid of such a negative side of the Internet, share their deep concern, which does not affect whether they have HPs or not. In Finland, since people are yet not so afraid, it seems that their concerns can still discourage them from having HPs.

It is interesting in Japan alone those who use the Internet for "healing" are more likely to have HPs. This may reflect the fact that there is a distinct Japanese use of HPs. A relevant result of supplemental analyses (not shown) is that the percentage of people displaying their own diaries on HPs is higher in Japan than in the other two countries (62.8% in Japan, 5.4% in Finland and 32.8% in Korea). It is considered that there is a similarity between showing diaries to anonymous readers and using the Internet for healing. This seems consistent with other Japanese distinctions in terms of "BB at home" and "where they use it." From analyses of the same dataset as this study, Kimura (2004) concludes that cyberspace in Japan is understood as an anonymous place and that Japanese people are reluctant to be deeply involved. According to him, people in cyberspace are not related to their real social networks. It is plausible that personal HPs in Japanese society function as a place for monologue, a hypothesis that matches our finding that Japanese HP users enjoy the Internet at home for healing.

However, people in Korea attempt to strengthen their real social networks or create new networks through the Internet (Kim 2004). Thus, Koreans think of communication on the Internet as being connected with real social networks. In Japan also, the analyses show that this variable plays an important role, but in a different sense than in Korea. Japanese HP users communicate with anonymous strangers with whom they would hardly like to have face-to-face conversation (note 1).

There has been a controversy as to whether

the Internet promotes or hinders people's social networks (Kraut et al. 1998, Wellman & Gulia 1999). The argument is that communication among immediate social networks is reduced, while "weak ties" in remote social networks are strengthened (Kraut et al. 1998). In Japanese society, very weak ties (which we call "anonymous ties"), much weaker than those Kraut et al. (1998), appear to make a difference.

A negative side of this Japanese characteristic is that people's abilities to get along with others in real social relationships may be lowered because they are too accustomed to weak social ties in cyberspace (Kimura & Saito 2006). This is especially true of some young people who stay at home without going out for long (said to be "housebound") a phenomenon sometimes criticized as being a specifically Japanese characteristic.

However, we also find a positive side, in that this Japanese distinct characteristic seems appropriate for those who do not need to keep relationship. For instance, such weak ties may activate Internet business and entertainment. In fact, "collect information" and "entertainment" in Japan are more strongly related to having HP than in Finland and Korea.

## 8. Conclusion

To summarize, a condition of having HPs is the motivation to communicate with others. But this is not a determinant, and Internet skills are also necessary. In addition, we found that the availability of equipment in the information environment, such as BB at home,

to be an important factor. Those who meet these criteria are more likely to have HPs than others in the three societies, which implies that these are "media characteristics" of HPs.

However, we also find some social-cultural differences. For example, what seems unique in the Japanese context is that social networks in cyberspace are assumed to be anonymous. This may reflect the fact that Japanese young people use the Internet alone at home without being aware of the real social world.

### Note:

1. We conducted supplemental analyses, with the result that "afraid of the Internet" in Finland is not significantly related to "afraid of society in general" (.093, n.s.). In contrast, we see a significant relationship between these two factors in Japan and Korea (Japan: .145,  $P < .01$ ; Finland: .200,  $P < .01$ ).

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# Administrative Evolution and Open Innovation <sup>[1]</sup>

## Keywords:

e-Government, CIO, SOA, Preventive Medicine, Innovation

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## Abstract

Our future society cannot be clarified or characterized without considering various factors related to IT. IT continues its fundamental development in the open innovation environment, where genius or outstanding talent does not necessarily play a central role to drive transformation. Rather, individual consumers, suppliers, workers, or any one who has the ability to engage in creative and collaborative activities brings transformation that leads to innovation. The Architecture of Participation is very crucial. In other words, the dissemination of IT depends on social architecture, or the agent that activates open innovation. Social development, in turn, depends on how we can facilitate social utilization of IT. Therefore, we must design a new social paradigm for active and open innovation.

This paper will discuss e-Government and Local e-government as a core infrastructure of innovation, upon which regional digital revolution is achieved. Also, the importance of the administrative CIO's role and responsibilities is explored in other part of this paper.

Currently, administrative CIOs are occupied with duties regarding IT security and system acquisitions. In period of emerging IT-based organization, CIOs must engage in technological management of IT, and cannot handle strategic knowledge management such as organizational reform. However, in order to fully utilize the potential capacity of IT for organizational and social transformation, the roles and responsibilities of CIOs must be greatly refined.

e-Government can be the infrastructure that facilitates the co-creation of new information and knowledge and the systemic chain reaction of innovation in partnership of industry, government, university, and the private sector. To promote innovation, CIOs must play a critical role, and their roles and responsibilities must be refined.

It is necessary for us to envision a new paradigm for open innovation, which will be utilized to achieve sustainable social development. In the new paradigm, e-Government and Local e-government should be emphasized as a core function. The infrastructure must be developed into a platform so that it can be applied to the entire society.

For innovative capabilities to be strengthened, we are required to obtain a wide range of knowledge both in the humanities and sciences. It is also necessary to find relationships among the knowledge, and create new knowledge and capabilities. Such a relation-building effort must become the foundation of creativity. As social applications of information technology and networks are increased and refined further, the CIO, as chief officer of an organization, needs to improve innovative capacity; in other words, to develop the ability to form relationships.

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## 1. The e-Government Initiative in Japan

From the mid-1990s, IT (Information Technology) and the Internet have served as fundamental infrastructure for a mega market economy to emerge on a global scale. This is called the 'Digital Economy', which has not ceased to grow ever since. In line with this trend, diversified relations of significant complexity have been defined and formed in society. Our future society cannot be clarified or characterized without considering various factors related to IT. IT continues to develop in a fundamental way in an open innovation environment, where genius or outstanding talent does not necessarily play a central role to drive transformation. Rather, individual consumers, suppliers, workers, or anyone who has the ability to engage in creative and collaborative activities brings transformation leading to innovation. This is the so-called 'Architecture of Participation'. In other words, the dissemination of IT depends on social architecture, or the agent that activates open innovation. Social development, in turn, depends on how we can facilitate social utilization of IT. Therefore, we must design a new social paradigm for active open innovation.

This paper will discuss e-Government and Local e-government as a core infrastructure of innovation, upon which regional informatization is achieved. Also, the importance of the administrative CIO's role and responsibilities is explored in another part of this paper.

The concepts of e-Government and Local e-government have gathered momentum throughout the world. In Japan, they are

considered as an integral part of *e-Japan Strategy* as well as succeeding *New IT Reform Strategy*. One of the priority policy programs is to deliver the 'world's most convenient and efficient electronic government' when it achieves its goal of 50% online processing of all applications and filings by 2010.

Past e-Government initiatives are documented in the "e-Government Evaluation Committee 2006 Report" (Chair: Osamu Sudoh; report published in 2007). This committee has been established within the Expert Committee on IT Strategy Evaluation.

In this section, the past e-Government initiative will be reviewed according to the abovementioned report (ibid. pp.6-16).

First of all, for the promotion of online applications and filings, one-stop service is going to be constructed. This is an initiative involving all ministries for procedures related to various applications and filings. Another measure is to establish an 'electronic government support center' to handle specific inquiries from users. These plans are being developed to meet service requirements from the user's point of view.

Secondly, the optimization of operations and systems are being conducted following the optimization plan as a government-wide initiative for 85 target operations and systems (23 common operations for all ministries; 62 operations for individual ministries). For these areas, the effect of optimization and system integration is considered to be significantly large. Additionally, joint delivery of public services and the simplification of various administrative procedures are being promoted in the collaboration between central ministries, central government and local

municipal bodies. Ministries and agencies are currently developing optimization guidelines to perform through cost-benefit analysis, and are introducing monitoring systems to measure the progress of the implementation and evaluation activities in accordance with the optimization plan.

In March 2006, a Chief Information Officer (CIO) conference was held to align optimization programs being performed by each ministry. In this conference, 'Operation/System Optimization Guidelines' were depicted, which formalized an organization scheme as well as common methodologies and procedures to promote the optimization programs. The guidelines articulate that each ministry must review operations and systems in conformance with the guidelines by focusing on areas where the effect of operational optimization and system integration will be significant. Actual measures include the utilization of common integrated systems and multiagency outsourcing of administrative processes. Operational processing time and cost must be qualitatively expressed as projected net reduction. The guidelines also state that each ministry must engage in activities according to 'Operation/System Optimization Guidelines', proceed with system design, development and operation, perform evaluation on an annual basis or when each phase of development is completed, and monitor every activity's status. (ibid. pp.9-10)

In relation to the operation/system optimization, total investment in FY2007 was successfully lowered by approximately 30% from the amount of appropriations (¥69.2 bil budgeted against ¥99.8 bil requested). This

reduction was achieved mainly by streamlining procurement procedures and carefully examining specifications, unit cost, and man hours. The reduction of the invested amount was reflected in the budget planning and appropriate adjustments were made.

As for the organizational scheme of the e-Government initiative, each ministry "shall be responsible for overseeing measures related to e-Government, such as the promotion of computerizing procedures related to interministry information system planning, development, operation, evaluation ...under the authority of the chief information officer (CIO) of each respective office and with support and advice from the deputy CIOs ", and "to foster and secure human resources with the necessary knowledge and expertise, for the government to proceed with information security measures in a unified manner...specific measures for the entire government will be promoted to strategically foster personnel and strengthen rapid reaction capacities of human resources"[2] (ibid. p.11).

In order to complete these specific tasks, the Program Management Offices (PMO) were created in FY2006 within each ministry under the authority of the CIO who will administer the entire functions assigned under the e-Government initiative. PMOs shall serve as interministry coordination offices, and be responsible for the development of 'Operation/System Optimization Guidelines ', the overall coordination of implementation and evaluation activities, the request/execution of e-Government related budget, and the coordination of acquisition of information systems.

Additionally, the Government Project

Management Office (GPMO) was established within the IT Policy Office of the Cabinet Secretariat in April 2006 so that policy measures for the optimization of operation/system common to all ministries would be further promoted, and the overall coordinating functions between each ministry would be enhanced. GPMO, therefore, will play a central role in making necessary adjustments to the specifications related to operations and systems common to all ministries and for managing the development process with the support of system integration activities and conferences held by ministries in charge. Based on government directions such as 'Basic Policies for Economic and Fiscal Management and Structural Reform 2006', GPMO shall enhance interministry cooperation and coordination, and review the accomplishment of the optimization plan and appropriations.

At the forefront of Local e-government initiatives, municipal governments are actively cooperating with the Ministry of Internal Affairs and Communication to implement Enterprise Architecture (EA) for the optimization of processes performed by Local governmental bodies. Along with these municipal EA projects, multiple Local e-governments have jointly outsourced operations and processes in line with the establishment of a Local e-government. This joint outsourcing initiative is to operate information systems at lower costs and to offer a high level of security. Administrative processes in local governments are being reviewed in a streamlining effort. Regional social networking service (SNS) has also been used to enhance interactive communication

with citizens to promote citizen participation in the public sphere. These are examples of structural reforms utilizing IT for local government (ibid. p.12).

One of the goals and social effects of the Local e-government scheme is, first and foremost, to generate effective demand in the IT sector. However, the essence of this scheme goes beyond the creation of demand. As we see in e-Government initiatives, IT can be effectively utilized to eliminate bureaucratic barriers, develop efficient administrative organizations, and improve the quality of public service. The Local e-government scheme is also effective for regional development when IT and networks are utilized so that a regional community is able to offer safety and security for its citizens. To achieve this purpose, a high level of risk management must be implemented, including immediate response and rescue operations in the occurrence of natural disasters such as an earthquake.

The concept of Local e-government starts from the introduction of an information system for the optimization of administrative processes and the enhancement of transparency. In other words, this concept has the implication of achieving overall optimization of process and information systems. To achieve this goal, government-wide initiative is necessary so that operation and system is reformed. Therefore, it is important to understand the process of administrative transformation and change management.

To establish Local e-government, sufficient financial and human resources must be provided. Financial accounting, tax, personnel

and other core systems have already been built and are currently in operation in most local governments. All personnel are using terminals connected to intra-agency LAN, and groupware, and personnel portal sites have been made available in some municipal governments. Currently, it is more important and necessary to construct external systems, such as electronic application/filing and acquisition, which will be coordinated with core systems and utilized to increase efficiency of administrative processes and enhance service quality. Furthermore, it is necessary to build multi-payment systems for tax return and authentication system. Without a cross-agency information system, highly efficient and transparent public administration and services cannot be provided. If each local government implements and operates these systems individually, it requires a huge investment cost and a large number of personnel who are capable of handling highly technical knowledge regarding the information system. Therefore, it is necessary for local governments to work with IT vendors to develop and operate the system, which results in shared cost and benefits. Given such circumstances, the concept of joint outsourcing incorporating data centers have been encouraged.

Both the central government and local governments have actively engaged in the e-Government initiatives. Various issues that should be solved have been identified.

The e-Government Evaluation Committee presented three viewpoints in *e-Government Evaluation Committee 2006 Report* as previously mentioned. From these viewpoints, the committee discussed challenges and

solutions for the promotion of e-Government (ibid. pp.4-5).

The first one of the three viewpoints is the 'visualization' of values from the user's standpoint and the implementation of a performance-oriented system. According to the report, it is necessary to visualize what the 'world's most convenient and efficient electronic government' is from user's perspectives. Accountability must be enforced for final users e.g. citizens and corporations as well as executive officers in charge of program execution. Furthermore, a performance-based system from the user's perspective must be thoroughly implemented whereby e-Government initiative would be comprehensively assessed not based on current administrative procedures and process but from the viewpoint of final users e.g. citizens and corporations. The report emphasized that PDCA cycle must always be followed so that the result of evaluation (check) could be explicitly provided as feedback to new policies and programs (action).

The second viewpoint is 'enhanced coordination of front office and back office reforms'. The report states that it is necessary to ensure improved usability for online applications/filings and aligned optimization of operation/systems for front office and back office, and accomplish detailed assessment to determine if overall optimality of e-Government is being substantially achieved.

The third viewpoint is the achievement of overall optimization through the implementation and utilization of common online systems, coordination of intra- and inter-ministries and agencies, cooperation of

central and local government, and partnership of public and private sectors. The report points out a potential for increase of burden on citizens and users due to duplicate investment into information systems, which should have been developed in a joint effort, and failure to achieve a real purpose as long as different offices engage in different programs and projects and their activities are unaligned. To avoid such a situation, it is necessary not only to provide and promote on authentication system, on integrated administrative network (LGWAN) and standardized and common systems, but also to standardize a data and code scheme for the systems, and evaluate implementation and utilization processes with regard to smoothness and effectiveness.

These requirements are a reflection of the importance of devising a performance reference model strongly focusing on user satisfaction, developing an organizational optimization plan, constructing an information infrastructure and standardizing a data scheme.

As mentioned earlier, e-Government and Local e-government require comprehensive activities from the three viewpoints. To achieve this goal, the role of CIO becomes critical as chief supervisor of the entire e-Government initiative. In the next section, the responsibilities of CIO to take in administrative organizations will be explained.

## 2. Administrative Organization and CIO

To enhance IT governance in administrative organization, the government of Japan established CIO in each ministry in 2002, and deputy CIOs were placed in 2003. The U.S.

Federal Government was one model cases in which IT governance enhancement programs were implemented.

In 1996, the Clinger-Cohen Act, known as the Information Technology Management Reform Act of 1996, was enacted during the Clinton administration. With this act, a CIO was designated within each agency and EA was introduced to establish a high level of IT governance.

A CIO's thirteen roles and responsibilities for Federal Government agencies are as follows [3]:

- IT capital planning and investment review
- enterprise architecture
- information security
- strategic planning of technology and information resources management
- human resource planning for information management
- e-Government initiatives
- acquisitions, development and integration of system applications and infrastructure
- data collection and paperwork reduction
- maintenance of a complete inventory of information resources
- public relations
- privacy
- information disclosure
- statistics

The GAO (Government Accountability Office) performed a survey for CIOs at 27 leading federal agencies from November 2003 through May 2004. Out of the thirteen roles for CIOs, the most important responsibilities are: IT capital planning and investment review, enterprise architecture, information security, strategic planning of technology and

information resources management, and human resource planning for information management.

More than half of all CIOs took on the responsibility of for the execution of the following six roles: e-Government initiatives, acquisitions, development and integration of system applications and infrastructure, data collection and paperwork reduction, maintenance of a complete inventory of information resources, public relations, and privacy. Fewer than ten CIOs only were performing the roles for information disclosure and statistics.

In total, 24 U.S. Federal Government agencies have a deputy CIO, who plays a critical role in executing multiple duties. The Government of Japan appoints a chief cabinet secretary or deputy vice-minister as a deputy CIO, with whom deputy assistant secretaries chosen from experts in the private sector provide support. The roles and responsibilities of deputy assistant secretaries for CIO, however, are not defined consistently throughout ministries in Japan, which is similar to the case in U.S. Note: *Nikkei Computer* magazine conducted an interview of deputy assistant secretaries for CIO in Japanese ministries and government agencies (*Nikkei Computer*, November 28, 2005). Seven secretaries out of 33 answered that the roles and authority of deputy assistant secretaries to CIO were not clear. 20 out of 33 stated that cross-agency decision-making and coordination were a hard task. (See also GAO, p.59)

There are two different types of appointment for CIO positions in U.S. Federal Government agencies: appointed officials and

career officials. The difference in terms of appointment and election has greatly impacted the performance of CIOs. There are merits and demerits in both ways. Appointed officials are senior Federal Government officials elected by the Executive Office of the President and relevant federal agencies, presidentially appointed, and confirmed by the Senate. On the other hand, career officials are all Federal Government officials except appointed officials.

Appointed officials have a closer connection to executives in decision-making organizations, and it is easier to take a top-down leadership for large-scale organizational reform. However, some issues require a commitment that is longer than the President's term of office, which is one of the demerits pertaining to appointed officials. On the other hand, while career officials have less exposure to politics while they are better able to respond to issues and challenges with a consensus of bottom and middle personnel, regardless of the President 's term of office. Currently, appointed officials are greater in number. Depending on the type of issues they have, the appointment system of CIOs may need to be flexible enough to undergo adjustment. (See GAO for p.51).

Again, the legal authorization of CIOs in U.S. Federal Government agencies was articulated by the Clinger-Cohen Act (CCA) of 1996. "The director shall perform the responsibilities set forth in the CCA by designating a CIO for the enhancement of organizational capabilities and resolution of issues related to IT management. According to the CCA, the CIO shall lead activities for, tracking and evaluating risks, investment

control for information systems, and management and reform of all major capital investment for information systems. The Federal Government agencies have enhanced their organizational capabilities by placing CIOs and have successfully resolved various IT management challenges (ibid. p.56). However, the concept of administrative CIO originates from private entities. As administrative organizations rely more on IT, the designation of CIOs has become a necessity.

The CIO's roles in private corporations are acquisition of information systems, IT capital planning and investment control, information security, human resource planning, and e-Commerce. In general, CIOs in the private sector do not undertake the duty of information disclosure (ibid. p.57).

As IT, network, and digital database become incorporated into the organizational infrastructure and the organization comes to depend more on IT, CIOs will play a cross-organizational role both in private entities and administrative organizations. It is an issue of how to define decision-making authority. In particular, administrative CIOs must meet the three requirements previously explained: result-based evaluation from the user's viewpoint, enhanced coordination between front and back offices, and the implementation and utilization of common infrastructure related to online systems. To proceed with e-Government initiatives based on these perspectives, CIOs will have more important roles to promote coordination among multiple organizations for IT governance in administrative agencies as well as the partnership between public and private

sectors.

Currently, administrative CIOs are occupied with duties regarding IT security and system acquisitions. In an emerging period of IT-based organization, CIOs must engage in technological management of IT, and cannot handle strategic knowledge management such as organizational reform. However, in order to fully utilize the potential capacity of IT for organizational and social transformation, the roles and responsibilities of CIOs must be greatly refined.

### 3. Potential capacity of IT to achieve transformation and services science

Until 1998, there had been many doubts with regards to the benefit that IT and the Internet would bring to society. In this sense, C. Freeman had an insightful view (See Freeman 1992). According to Freeman, one of the common characteristics for major OECD countries was that the growth rate of labor productivity was extremely high while capital productivity exhibited net growth in the electronic industry such in the production of computer and electronic devices. However, in many countries, the paradigm of energy-intensive or resource-intensive mass production was still dominant in a large part of the entire economy. Corporate organization, industry regulations, social institutions, and investment in infrastructure were designed and developed in line with the paradigm. Therefore, a new paradigm based on IT was not introduced in the entire economy, and the externalities of IT were only unevenly observed. Even if companies invested in IT on an individual basis, the

capacity with which IT had to achieve transformation could not spread throughout the economy as long as corporate organization, industry regulations, social institutions, and infrastructure were still confined to the older paradigm of mass production. The benefit that IT could realize in the society was limited and only seen in specific areas.

Freeman once mentioned based on the research result of SPRU (Science Policy Research Unit) in terms of long-term trend of labor productivity and capital productivity from 1948 through 1984 in England economy for major industries (40 industries defined by Cambridge growth model). Labor productivity was high in the electronic sector, in particular, computer and electronic device industries. In these industries, in-house technology was most extensively used in design, manufacturing, inventory management, marketing, and management. They were the only industries where net growth in capital productivity was observed. Moreover, labor productivity showed substantial growth in sectors where microelectronics was heavily used in both product and process technologies. In such sectors, capital productivity improved to some extent, for example, in scientific devices, and electronic communication, and watches. These industries can be regarded as part of the electronic industry.

On the other hand, in the service sector, major businesses such as banking, insurance and distribution achieved a certain level of growth by utilizing information technology. Labor productivity in these industries clearly improved with the introduction of new

technologies (although the measurement methodology of labor productivity had imperfections). However, the growth in productivity varied greatly from company to company, or country to country. This is because technological development was heavily dependent on organizational, institutional, and structural changes. In other service sectors, the introduction of information technology was not necessarily smooth. The growth rate of labor productivity remained either extremely low, or was stagnant. They were lack of capabilities for the design, utilization, and maintenance of software system.

The implementation of information infrastructure, organizational reform by corporations and administrative agencies to better utilize IT, and reform of social institutions and industry legislation are, according to Freeman, the driving force for the existing techno-economic paradigm to shift into a new techno-economic paradigm. In the end, higher labor productivity growth and net capital productivity growth observed in the IT industry will spread to the entire economy and bring qualitative benefit. In addition, the mutual effect of information and knowledge can accelerate comprehensive growth of scientific technologies and linkage of R&D activities. This will spark chain reactions of innovation, and bring substantial differences to the entire economic and social system.

The ratio of the service sector to GDP in the market economy of advanced countries has become substantially large and in developing countries, is also growing. However, the productivity in the service

sector, including administrative services, is hard to measure. Due to this, a system of measurement based on specific criteria for achieving management optimality is hard to define. It is assumed that this issue has caused the labor productivity in the service sector to be not particularly high compared to that of manufacturing industries. Therefore, it is necessary to provide a system of measuring service values and a plan to achieve management optimality for maximizing the values so that IT should be utilized based on a rational assessment system to achieve transformation.

Based on research results in services science [4], we must consider deeply the creation of an administrative service, for which measurement of service values is critical.

Data pertaining to e-Government must be gathered for analysis to rationally provide measurement criteria for assessing service value associated with administrative services. Also, the optimality model for administrative bodies must be further adjusted. e-Government can be the infrastructure that facilitates the co-creation of new information and knowledge and the systemic chain reaction of innovation in the partnership of industry, government, university, and the private sector. To promote innovation, CIOs must play a critical role, and their roles and responsibilities must be refined as previously mentioned.

#### 4. Regional information platform and open innovation

It is necessary for us to envision a new

paradigm for open innovation which will be utilized to achieve sustainable social development. In the new paradigm, e-Government and Local e-government should be emphasized as a core function. The infrastructure must be developed into a platform so that it can be applied to the entire society.

Joint outsourcing helps multiple government agencies and local bodies utilize common information systems. However, each information system has a number of identical software modules. In the framework of common infrastructure for e-Government and Local e-government built based upon SOA (Service Oriented Architecture), common functions are built into modules so that efficiency and transparency in administrative systems can be developed. Hokkaido government and municipalities serving local services are already joining efforts. The following section explains social transformation via a wider-area collaboration of Local e-government.

SOA is a group of independent software modules, each of which is structured to support the requirements of a certain job process and/or common functionality across entire job functions. They are reusable and distributed over the network. The relationships against the modules are assigned by controllers to suit overall system architecture. Duplicate investment can be avoided with SOA, and a drastic decrease in cost can be achieved.

The concept of Local e-government can be strategically developed for the regional growth of the society. SOA is used to modularize software applications which will have varied

usage not only for administrative processes but also for administrations in public facilities, hospitals, schools, and day care centers. The outsourcing of SOA-based systems with data centers will greatly contribute to the performance improvement of local SMEs.

The concept of e-Government initiatives, as previously mentioned, can be a driving force for complete transformation of the regional community. To achieve this goal, it is important for us to utilize not only administrative information systems but also medical, welfare, educational institutions and facilities to actively utilize information facilities and infrastructure. Even local private corporations and households should participate.

In many advanced countries, aging society has become a serious social issue. In this context, it is important to prevent the increase of medical costs and to consider preventive health. Various research projects for preventive medicine utilizing IT are currently underway in the world.

I have also taken part of the development of a health management test bed using sensor networks, which is to serve as an empirical research platform [4]. The primary goal of the research is to organize a preventive health system to curb deterioration due to various adult diseases, such as high blood pressure, diabetes, kidney disease, and cardiac illness, to prevent complications, and to support secondary prevention for the improvement of health condition. Wearable bio-sensors and earthed indoor sensors are in place to obtain patient's ecological data. The data is transmitted from Mote client to the data center via IP-VPN. Data is made anonymous

before being sent over remote grids. Advanced data analysis is performed for a large volume of collected data pertaining to body movements, and is reported by the system to designated doctors. This is to support medical diagnosis and consultation by doctors for health management. (See Figure)

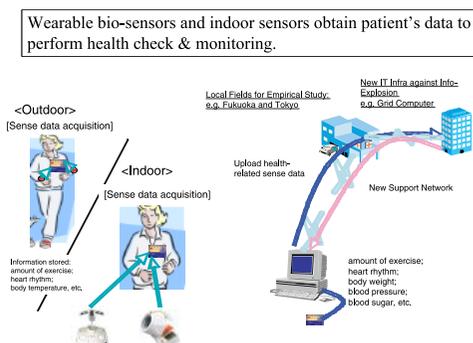


Figure: Health Care Monitoring System using Sensor Network

If the research produces certain outcomes, it will be upgraded into a larger empirical initiative using the research infrastructure of the sensor network and ASP, which is used to introduce preventive health services and security services.

As already mentioned, several leading municipalities are developing SOA-based information infrastructure in a joint effort. The Japanese medical insurance system has been reformed recently to prevent the increase of medical costs, through health prevention and management efforts in local communities. Therefore, the management of medical and health-related information at the community level has become an important issue. In this regard, it is possible to take a strategic approach to the evolution of local communities by incorporating the community

model based on the sensor network infrastructure into the entire Local e-government scheme.

The SOA concept is being promoted by these leading local governments, in which software is modularized and used for a variety of purposes. Software modules are not only for government administration but also public facilities, hospitals, and daycare centers. If the aforementioned local health management architecture using sensor networks is linked to this joint SOA initiative, the local information infrastructure would increase optimal efficiency in management of medical and welfare facilities where new quality services could be created. Under such circumstances, the role of CIOs is of critical importance. They are required not only to achieve governance for information technology, management capacity, legal compliance and process capabilities, but also to provide highly strategic management.

Many SMEs have actively engaged in B2B (business-to-business e-commerce) while they respond as required, to the needs for B2C (business-to-consumer e-commerce). Security issues with authentication and electronic signatures, high-level maintenance and operation of applications, storage in compliance with J-SOX (trade record data), and other development and maintenance issues of information systems are critical for SMEs which have only limited financial and human resources. Therefore, for SMEs, which is an integral part of the society, server maintenance should be undertaken in joint efforts utilizing data centers and ASP. Also, the concept of SOA should be developed and introduced into the information infrastructure

so that it can better respond to the needs in the digital economy.

The management of local communities should be handled by industry, administration, local residents, research and educational institutions in cooperation with people from different backgrounds who can share opinions and ideas to develop and utilize individual creativity for the creation of a new local community. Furthermore, in the future, medical prevention and health management and security services can be provided based on the established IT infrastructure for local communities using sensor networks, remote grid computing, and advanced analysis of a large volume of data in addition to the data centers and ASP. Then, it is possible to envision a future social architecture established upon the local communities that achieve the coordination of grid computing and sensor networks.

As explained in this paper, CIOs, deputy CIOs, and deputy assistant secretaries for CIOs are extremely important so that the transformational capabilities of IT can be utilized, to promote innovation. Their duties must be adjusted according to need. In the future, one of the roles CIOs should perform is strategic organizational change management, and relationship management. For open innovative capabilities to be strengthened, it is necessary for us to obtain a wide range of knowledge both in humanities and sciences. It is also vital to relate the knowledge, and create a new knowledge and capabilities. Such a relation-building effort must become the foundation of creativity. As social applications of information technology and network are increased and refined further, CIOs, as chief

officers of organizations, need to improve innovative capacity, which is to develop the ability to form relationships.

#### Note

- [1] The Japanese revised version of this English paper will be published as an article of a Japanese book. (Oct. 15<sup>th</sup> 2007)
- [2] IT Strategic Headquarters (2006), *Priority Policy Program*, July 26, 2006, Government of Japan. p.60; 105
- [3] NTT DATA AgileNet L.L.C and Digital Government Editorial Desk in NTT Data Corporation (2007), *GAO-Beikoku GAO Denshi Seihu Report*, Nikkei BP Planning, Inc. See pp.48-53. Referred to as 'GAO' in this paper.
- [4] 'Services science' is an area for research and analysis where experiences and technical intuition have been traditionally valued. By implementing scientific approaches based on hypothesis and models, the optimality of services in various areas is clarified. The application of knowledge in mathematics, physics, engineering, and social sciences are necessary. See Abe (2005) and Council on Competitiveness ed. (2005) for details.
- [5] This paper incorporates insights and knowledge from 'services science', a new interdisciplinary science field. Japan's e-government strategies must be analyzed from political science perspectives for further development of research in this area. A part of our research outcome is explained in Gotoh (2006), and Gotoh and Sudoh (2007).
- [6] MEXT Grant-in-aid for scientific research on priority areas, 'Cyber Infrastructure for the Information-explosion Era' (Project chair: Masaru Kitsuregawa), The Ministry of Education, Culture, Sports, Science and Technology. <http://www.infoplosion.nii.ac.jp/i-explosion/ctr.php/m/IndexEng/a/Index/>

infoplosion.nii.ac.jp/i-explosion/ctr.php/m/IndexEng/a/Index/

Research Group B01 Theme: The co-creation and governance of economic and social schemes in the knowledge-based society, Group chair: Osamu Sudoh. See Sudoh (2007a, 2007b) for details.

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# A Path Analysis Model for Development of Environmental Education Program to Promote Environmentally Responsible Behavior

Keywords:

Environmental education, Environmentally responsible behavior, Path model

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## Abstract

People have been trying various methods for solving the environmental issues and promoting a the sustainable society. Although the number of such people has increased thanks to environmental education programs to protect the environment, it is insufficient for developing an effective program that promotes environmentally responsible behavior. Our final objective is to develop an effective education program to make people environmentally responsible behavior. We refer to several existing environmental education curricula and psychological processes and present design a questionnaire technique we designed to solve questions encouraging how people perceive the environment and how their behaviors relate to their perceptions. We illustrate Based on the research, we develop a path model we developed, based on research and taking into account people's interests, motivations, and behaviors, for creating developing a program to promote environmentally responsible behavior. By analyzing the model, we argued determine that awareness of cost has the greatest effect on people's environmentally responsible behavior.

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## 1. Introduction

If we are to create a sustainable society, we would need to deal effectively with such environmental problems as air and water pollution, the destruction of the ozone layer, the over-harvesting of renewable resources, and the exhaustion of nonrenewable resources. Some governmental solutions to these problems are to promote technical developments that will result in the widespread use of hybrid cars and other energy-saving products (METI 2004), recycling laws (MOE 2004a), and the regulation of vehicle categories in specified areas (MOE 2005). Here we would like to focus on environmental education to promote environmentally responsible behavior (Hirose 1995, Sugiura 1998).

The environmental education in Japan, which began as an action program for the pollution issue of the 1970's, has prevailed in various fields such as school education, lifelong learning, and corporate education. However, we know that while these education programs could teach environmental knowledge and attitude but they could not promote environmentally responsible behavior. A questionnaire survey by the Ministry of the Environment, Japan (MOE 2004b) found that environmentally responsible behaviors that are not required by law (such as trash separation) and that do not affect the consumer's budget directly (such as saving electricity or water) are practiced by less than 50% of the population. We don't have the answer to this problem.

There are many models of human percep-

tion with regard to environmentally responsible behavior in the field of the social psychology. Hirose (1994) proposed a factor-relational model of environmentally responsible behavior and discussed four factors influencing that behavior. He also verified the validity of his model by using surveys. Some experimental studies based on Hirose's model (Nonami et al. 1997, Sugiura et al. 1998, Nonami et al. 2002, Yorifuji & Hirose 2002) demonstrated various factors influencing environmentally responsible behavior, and Koike et al. (2003) and Misaka (2003) developed a specific model based on Hirose's general model. However, these were not designed with environmental education in mind.

People's environmentally responsible behavior is important to solve the environmental problem. However, we don't have the environmental education program that promotes environmentally responsible behavior. To develop an effective program, we have to grasp the mental process of learners, and influential factors.

Our purpose in this study is to clarify what kinds of factors promote environmentally responsible behavior. We used a questionnaire to survey people's environmental perceptions and environmentally responsible behavior and developed an environmental behavior model.

Section 2 overviews the psychological approach concerning of environmental education and environmentally responsible behavior. In Section 3, we describe a radical model for developing a path model, and offer an assumption based on the radical model. Section 4 explains a method of

questionnaire survey based on the assumption and Section 5 develops the path model. In Section 6, we discuss the path model and draw outgive a conclusions in Section 7. Section 8 remarks on further works.

## 2. Relevant study

In this section, we overview some surveys in the area of psychology concerning of environmental education and environmentally responsible behavior which relate to a framework for our researchof the study.

### 2.1 Environmental education

Environmental education appears in different forms. Abe (1992) divides it into three categories as inlike figure 1: the first, fast category is about education in the environment, the second one, about education about the environment, and the final one, about education for the environment. He presented the view that the purpose or content of education changes by age. In the age of childhood, education occurs they are educated mainly in the environment. Education at schools about theThat of school-age educated about environment and adult education is adulthood for the welfare of the environment.

Education in the environment refers to the environment as the place or method of education. In this education, the experience is important and the purpose of the education is covers a wide in scoperange of fields (ex. sensitivity, ability to solve problems, engage in human relationships, understand, international issues.) Concretely, it involves they are camping, hiking, factory tours, trash collection

activity, picker action and so on. Nakagawa et al. (2005) examined the effect of long-term camping and short-term camping, and . As a result of the examination, he insists that long-term camping significantly improve the judgment of and the concern for of nature, and short-term camping significantly improves improve the social skills. Sato et al. (2005) declared that the experience based on outdoor educational programs improves acknowledged- ment of nature and awareness of the need for environmental protection.

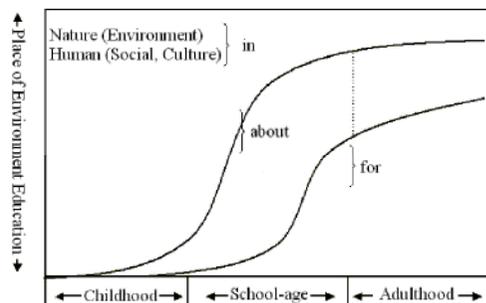


Figure 1: Lifelong learning and environmental education. (Abe 1992)

Education about the environment refers to environment as content of education. The purpose of this education is to deepen the knowledge and understanding of it. The objects of this educationthat are various issues asides, such as, the global warming problem and the waste problem in one 'sproblems in your region, and the methods of education are also varied, and include various like the lecture, exploration, experiment, game and e-learning (Sekiya 2002, Fukuda 2004).

Education for the environment refers to the environment as the purpose of education. In this education, consideration of the environment is the object that we have to

make consideration, and the purpose of education is to study attitudes the attitude and behavior toward for that end. However, we have known had known that while such education can could teach environmental the environmentally knowledge and attitude, but it can could not promote the environmentally responsible behavior.

Imamura (2002) declares that the final purpose of environmental education is to solve environmental issues using various functions of education. Some of the aims are, to acquire sensitivity, foster the ability to solve problems, impart knowledge and attitude. Existing environmental education is accomplishing these aims but is does not achieving the accomplish final purpose of promoting behavior to solve environmental issues. Through. In what kind of process does an appropriate education change a person 's behavior?

## 2.2 The psychological Psychological approach to environmentally responsible behavior

Many models of human perception with regard to environmentally responsible behavior are proposed in social psychology,; three of which are Hirose's (1994) factor-relational model of environmentally responsible behavior, Koike et al.'s (2003) structural model of the perception of environmental issues, and Misaka 's (2003) model of the perception and the behavior with regard to environmental of environmental issues regarding those issues. Hirose (1994) proposed a factor-relational model of environmentally responsible behavior and discussed four factors influencing that behavior. He also verified the validity of his model by using surveys. Koike et al. (2003) and Misaka (2003) developed a

specific model based on Hirose's general model.

There are several some experimental studies based on Hirose 's model. Nonami et al. (2002) shows presents that the personal behavior of the subjects in their study was influenced by attitudes toward the environment issue, while group behavior was affected by attachment to river. Sugiura et al. (1998) show shows that the recycling action by a volunteer group in their study influenced feasibility evaluation for recycling and social norm awareness, resulting in as a result, the rate of recycling behavior increase in increased. Yorifuji et al. (2002, 2003) examine determinants of children 's waste-reduction behavior, and show presents that there is a difference in the factors that influence factor that influences waste-reduction behavior in between children and in parents. Nonami et al. (1997) researched the effects of cognitive variables on recycling behavior, such as the effects of various media influences influence on the cognition and behavior.

There is are a lot of research that clarifies various factors researches that lead clarify various factors to provide for environmentally responsible behavior. However, their models don't indicate But their model didn 't clarify that what kinds of factor have the most does more impact on people 's environmentally responsible behavior in people. We need to know more concrete factors to develop more effective environmental educational programs.

## 3. Framework for developing environmental education programs to promote environmentally responsible behavior

### 3.1 A radical model to develop a path model We referred to environmental education

curricula and social psychology's several social psychology models in the process of our research, and developed a framework to develop the path model. This framework is as shown in Figure 2.

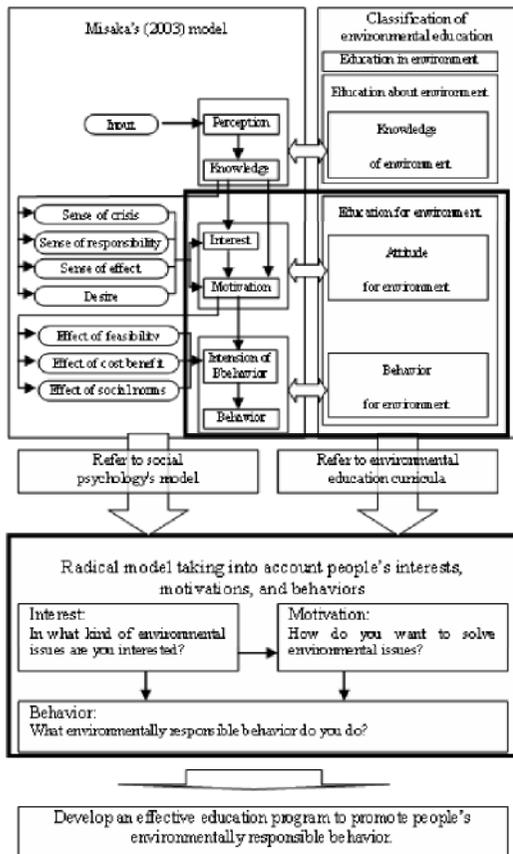


Figure 2: Framework for environmental education program development

Education for environment has aimed to teach learn the attitude and behavior for environment protection. Based on this aim, when environmental education curricula is made to correspond to psychological processes, and the attitude toward the for environment corresponds to interest and motivation, the behavior toward the for

environment corresponds to intention of behavior. Misaka (2003) explained that interest is the a step in which it is interested about objective is shown, motivation is the a step that involves a has vague sense of purpose with some relations for object want, and behavior is the a step where intended action is was actually carried outdone. He separates intention of behavior and behavior itself. However, we consider define that intention of behavior includes behavior, because based on Misaka 's assumption, if the intention is expressed the act will be carried out Misaka assumes that it was to be executed without fail in case of one decided in the step of the intention of behavior.

Based on this the framework, we developed a develop a radical model taking into account people's interests, motivations, and behaviors, and to develop a path model. Behavior is based on provided for by interest and motivation, and motivation is based on provided for by interest.

What kind of interest and motivation does does the person who behaves forenvironment have have? We need to know the answer to develop a program for promoting environmentally responsible behavior.

### 3.2 Factors of a radical model

Based on a radical model, we will discuss about some factors that include included interest, motivation, and behavior. See As a result, we develop figure 3 for details. in detail Interest

The interest in to environmental issues, which began, begun as concern about an

interest for the pollution issue of the 1970's, expanded to has prevailed in various other areas, fields such as the disruption of nature, pesticide contamination, depletion of the ozone layer, and global warming. There are some classifications for some of these various problems. Umino (1993) classifies them into four categories: industrial nuisance, livelihood nuisance, large-scale development issues, and global environmental issues; that is, from the , depending on viewpoint of the social mechanism of environmental destruction involved. Ueta (1991) classifies them into three categories, environmental pollution, destruction of amenities, and disruption of nature, based on the depending on grouping of the main environmental problems of the white paper on environment in Japan. Naito (1998) classifies them into local issue and global issues.

	Social environment	Nature environment
Local	Pollution issue Waste problem	Pesticide contamination Decrease of the immediate natural environment
Global	Energy issue Breadbasket issue	Depletion of ozone layer Desertification

Table 1: Classification of interest for environmental issue

We classify interest in these areas into four categories depending on two axes: nature-social axis and Naito's classification as shown in Table 1. As for local-social issues, there is there a pollution issue and a waste problem. As for local-nature issues, there is are a pesticide contamination and the decrease of the decreasing immediate natural environment. As for global-social issues, there is the energy

issue and the breadbasket issue. As for global-nature issues, there is depletion of ozone layer and desertification.

#### Motivation

What kind of motivation promotes people's environmentally responsible behavior in people? We classify motivation into seven categories based on previous studies. In existing environmental education, it was important to discover the causes and to change people's intention. Enomoto (1994) insists that not only such education their methods but also practical knowledge is necessary. Sugiura et al. (1998) show that movement that deal with problems, such as for problem, for example recycling action by volunteers, improve behavior toward the for environment. Based on nationwide survey of junior high school student in the Netherlands, Kuhlemeier et al. (1999) declare that awareness of cost is closely related to behavior for environment based on nationwide survey of junior high school student in the Netherlands. According to Hirose's experiment, many participants of a virtual world game answer that social reform and system reform are more important than compared with the question on the problem of waste. Based on these previous studies, we problem. We assume seven factors as motives for involvement: discovering causes, changing intention, gaining practical knowledge, and becoming aware awareness of movements, awareness of cost, awareness of social reform, and awareness of system reform, as motive based on these previous studies.

#### Behavior

In the report of survey research of lifestyle

gentle tender to the environment, the ministry of the environment classifies behavior for the environment into five categories. One of them, to decrease of negative environmental impact of daily life, corresponds to environmentally responsible behavior as that we define. The ministry suppose. Ministry of the environment classifies it into four categories: selection of product and service with little few environmental negative impact loads, energy conservation, domestic wastewater treatment, cooperation in separation of trash. separated collection. We categorize assume these four factors as behavior.

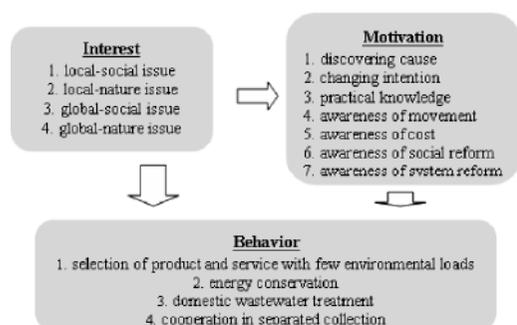


Figure 3: Detailed model taking into account people's interest, motivations, motivations, and behaviors

#### 4. Method

We conducted a questionnaire technique to develop a path model.

Questionnaire item: Based on assumptions in assumption of Section 3.2, we formulated a questionnaire as follows.

Interest: There were ten Ten questions about interest in environmental issues (e.g., "Are you interested in global warming? " and "Are you interested in the issue of energy sources being used up? "). Subjects evaluated their interest on a scale from 1 ( "completely

unconcerned") to 4 ("highly interested").

Motivation: Twenty seven questions about their the motivation for environmentally responsible behavior (e.g., "Do you think that you should do something to conserve the conservation of energy?" and "Do you want to participate in a the movement? "). For 24 of the questions, subjects evaluated Subjects evaluate their motivation on a scale from 1 ("irrelevant") to 4 ( "extremely important"), for except three questions, one question, is rated on a scale of 1 to 5, and for other two questions, are rated on a scale of 1 to 6.

Behavior: There were twelve Twelve questions about environmentally responsible behavior behaviors and how often the subject behaves in an environmentally responsible ways. These subjects evaluated their behavior behaviors on a scale from 1 ( "never") to 5 ("always").

Subjects: The subjects were 123 university students and 178 persons concerned with to environmental education<sup>(1)</sup>. The valid response is 268.

#### 5. Results

Based on the research, we executed factor analysis<sup>(2)</sup> and path analysis<sup>(3)</sup>. As a result, we developed a path model taking into account people's interest, motivation, and behaviors, motivations, and behaviors for developing a program to promote environmentally responsible behavior. We excluded some questions because many of the subjects did not answer<sup>(4)</sup>.

##### 5.1 Variable extraction

As a result of factor analysis, we extracted

extract three variables of interest, seven variables of motivation, and two variables of behavior as follows.

**Interest:** Factor analyses (principle component analysis using varimax rotation) revealed that the ten questions about interest factors measured three latent variables. Contrary to our assumption, global environmental issues did issue does not divide into social and natural nature. We labeled variable 1 ( $X_1$ ) as life environment, variable 2 ( $X_2$ ) as global environment, variable 3 ( $X_3$ ) as nature environment.

**Motivation:** Factor analyses (principle component analysis using varimax rotation) revealed that twenty- four questions about motivation factors measured seven latent variables. Contrary to our assumption, awareness of economy is revealed extracted instead of discovering cause. We labeled variable 1 ( $Y_4$ ) as concrete environmental consciousness, variable 2 ( $Y_5$ ) as awareness of movements, variable 3 ( $Y_6$ ) as awareness of social reform, variable 4 ( $Y_7$ ) as awareness of cost, variable 5 ( $Y_8$ ) as awareness of system, variable 6 ( $Y_9$ ) as abstract environmental consciousness, variable 7 ( $Y_{10}$ ) as awareness of economy.

**Behavior:** Factor analyses (principle component analysis using varimax rotation) revealed that eleven questions about behavior factors measured two latent variables. Contrary to our assumption, behavior divides into two variables. We labeled variable 1 ( $Y_{11}$ ) as deliberate environmentally responsible behavior, variable 2 ( $Y_{12}$ ) as routine environmentally responsible behavior. Deliberate environmentally responsible behavior has a relatively low rate of practice.

We had have assumed these issues four factors in of behavior, but however, results of factor analyses show that people 's environmentally responsible behavior depends on burden and degree of daily behavior.

### 5.2 Developing path model

We executed path analysis to develop a path model taking into account people 's interest, motivations, motivations, and behavior behaviors for developing a program to promote environmentally responsible behavior.

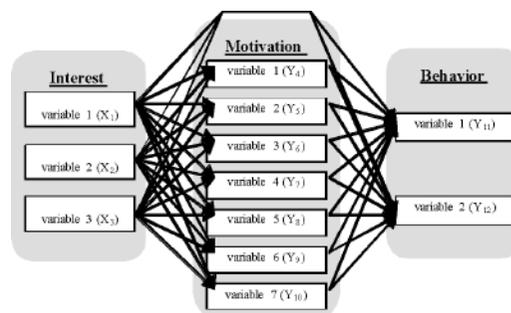


Figure 4: Causal model of taking into account people's interest, motivations, motivations, and behaviors

Based on those variables, we developed figure 4 as a causal model that corrected the detailed model. Each variable of behavior is provided for by each variable of interest and motivation, and each variable of motivation is provided for by each variable of interest. The regression equation of the causal is as follows.

$$Y_j = \sum_{i=1}^3 p_{ji}X_i + p_{jj}R_j \quad (j=4, \dots, 10)$$

$$Y_k = \sum_{i=1}^3 p_{ki}X_i + \sum_{j=4}^7 p_{kj}Y_j + p_{kk}R_k \quad (k=11, 12)$$

Based on the causal model and this regression equation, we developed a figure 5

as a path model taking into account people's interest, motivations, motivations, and behavior behaviors for developing a program to promote environmentally responsible behavior<sup>(6)</sup>. Path drawn on this model is significant regression ( $p < .05$ ).

Life environment exerts a significant influence on concrete environmental consciousness, awareness of movements, awareness of social reform, abstract environmental consciousness ( $p_{4,1} = .233^{***}$ , ( $p < .001$ );  $p_{5,1} = .126$ , ( $p < .05$ );  $p_{6,1} = .260$ , ( $p < .001$ );  $p_{8,1} = .119$ , ( $p < .05$ )). Concrete environmental consciousness and awareness of social reform are high like the person with high life environment.

Global environment exerts a significant influence on concrete environmental consciousness, awareness of movements, awareness of social reform, awareness of cost, awareness of system, deliberate environmentally responsible behavior ( $p_{4,2} = .123$ , ( $p < .05$ );  $p_{5,2} = .155$ , ( $p < .01$ );  $p_{6,2} = .222$ , ( $p < .001$ );  $p_{7,2} = .181$ , ( $p < .01$ );  $p_{8,2} = .163$ , ( $p < .01$ );

$p_{11,2} = .160$ , ( $p < .01$ )) Awareness of social reform and awareness of system are high like the person with high life environment.

Nature environment exerts a significant influence on awareness of cost, abstract environmental consciousness, awareness of economy, deliberate environmentally responsible behavior ( $p_{7,3} = .198$ , ( $p < .001$ );  $p_{9,3} = .145$ , ( $p < .05$ );  $p_{10,3} = .126$ , ( $p < .05$ );  $p_{11,3} = .157$ , ( $p < .01$ )). Awareness of cost is high like the person with high nature environment.

Deliberate environmentally responsible behavior receives significant influence influences from abstract environmental consciousness, awareness of movements, awareness of social reform, awareness of cost, awareness of economy ( $p_{11,4} = .166$ , ( $p < .001$ );  $p_{11,5} = .166$ , ( $p < .001$ );  $p_{11,6} = .122$ , ( $p < .05$ );  $p_{11,7} = .345$ , ( $p < .001$ );  $p_{11,10} = .131$ , ( $p < .01$ )) other than global environment and nature environment ( $p_{11,2} = .160$ , ( $p < .01$ );  $p_{11,3} = .157$ , ( $p < .01$ )). Deliberate environmentally responsible behavior is high like the person with high awareness of cost.

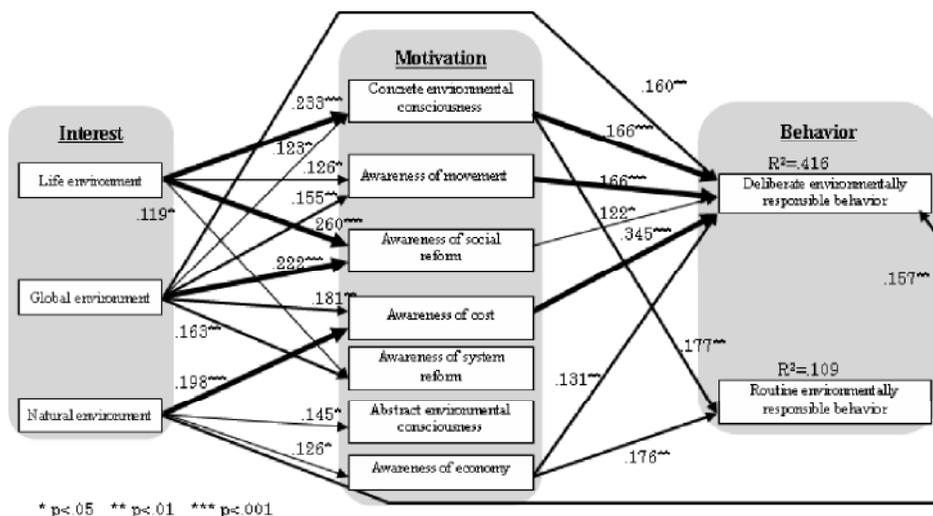


Figure 5: Path model taking into account interest, motivation and behavior

Routine environmentally responsible behavior receives significant influence from abstract environmental consciousness and awareness of economy ( $p_{12,4}=.177$ , ( $p<.01$ );  $p_{12,10}=.176$ , ( $p<.01$ )). Routine environmentally responsible behavior is high like the person with high abstract environmental consciousness and awareness of economy.

## 6. Discussion about path model

The result of this study does not reflect society as a whole, because this survey covered only two groups: that university students, and persons concerned with to environmental education. For example, there is a possibility of to become different results according to result by level of living style and knowledge of environment. It is important to compare the present results with a more widespread generalized survey to generalize.

From the factor analysis and the path model, we understood that environmentally responsible behavior was divided into two behaviors, and each behavior was affected by different factors. Deliberate environmentally responsible behavior is receives most highly influenced by influences from awareness of cost. Multiple correlation coefficient is  $R^2=.416$ . As a result, we think that deliberate environmentally responsible behavior is high like the person with high awareness of cost. From here onwards, we believe insist that our model can explain deliberate environmentally responsible behavior though there is a limit of generalization.

Existing environmental education tries to raise concrete and abstract environmental

consciousness to promote environmentally responsible behavior. To raise concrete environmental consciousness, current education programs focus on methods or rules of environmental protection in as their content. To raise abstract environmental consciousness, ethics and morality are taught. Such an education programs can teach environmental attitudes but it cannot promote environmentally responsible behavior. However, Even though our model didn't show that couldn't determine that the concrete environmental consciousness and abstract environmental consciousness have the greatest effect on people's environmentally responsible behavior.

## 7. Conclusion

We referred to several existing environmental education curricula and psychological processes and developed a develop a questionnaire technique to understand solve questions how people perceive the environment and how their behaviors relate to their perceptions. Based on the research, we develop a path model, taking into account people's interest, motivations, motivations, and behavior, s for developing a program to promote environmentally responsible behavior. By analyzing the model, we determined that awareness of cost has the greatest effect on people's environmentally responsible behavior. From this deduction, we inferred that the more aware of cost of people are, the more likely they are to behave in ways that are environmentally responsible.

We infer that it is necessary for education to raise the awareness of cost in order to

promote environmentally responsible behavior. In the future, we want to propose a new education program to promote people's environmentally responsible behavior based on this result, and verify the education effect.

8. Future works

Environmental education nowadays has the aim of deepening concrete or abstract environmental consciousness to encourage environmentally responsible behavior. Therefore, we would like to pursue a concrete education program to deepen awareness of cost and verify education effects.

Acknowledgment

I thank reviewers and all of subjects who cooperated into our survey.

Footnote

<sup>21</sup>In our study, we executed factor analysis with university students and persons concerned with environmental education. The results of each factor analysis of the two groups is almost the same.

<sup>22</sup>Factor analysis (Azuma, 1974) is executed by SPSS 12.0J for windows.

<sup>23</sup>Path analysis (Yasuda and Umino, 1977) is executed by Amos 4.01.

<sup>24</sup>One question might be overlooked because the question was between the table and the table.

<sup>25</sup>All path coefficients and multiple correlation coefficients are as follows.

		Y <sub>4</sub>	Y <sub>5</sub>	Y <sub>6</sub>	Y <sub>7</sub>	Y <sub>8</sub>	Y <sub>9</sub>	Y <sub>10</sub>	Y <sub>11</sub>	Y <sub>12</sub>
X <sub>1</sub>	life environment	.233***	.126*	.260***	.113	.119*	.108	.069	.067	.098
X <sub>2</sub>	global environment	.123*	.155**	.222***	.181**	.163**	.023	-.041	.160**	.029
X <sub>3</sub>	nature environment	.044	.086	.049	.198***	.100	.145*	.126*	.157**	-.013
Y <sub>4</sub>	concrete environmental consciousness								.166***	.177**
Y <sub>5</sub>	awareness of movement								.166***	.058
Y <sub>6</sub>	awareness of social reform								.122*	-.004
Y <sub>7</sub>	awareness of cost								.345***	.039
Y <sub>8</sub>	awareness of system								.033	.093
Y <sub>9</sub>	abstract environmental consciousness								.082	-.017
Y <sub>10</sub>	awareness of economy								.131**	.176**
Y <sub>11</sub>	deliberate environmentally responsible behavior									
Y <sub>12</sub>	routine environmentally responsible behavior									
	multiple correlation coefficient	.071	.047	.120	.085	.051	.033	.022	.416	.109

\* p<.05 \*\* p<.01 \*\*\* p<.001

(6) Path coefficient wrote p<sub>ji</sub> as p<sub>j,i</sub>.

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# Beyond the KISS Principle for Agent-Based Social Simulation<sup>(1)</sup>

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## Abstract

The "Keep It Simple, Stupid" (KISS) principle stated by Robert Axelrod is a good guideline to model agent-based social simulation. However, to cope with real phenomena, we must go beyond the KISS principle. This paper re-examines the principle and discusses the underlining requirements for agent-based modeling using our recently developed agent-based models as examples.

## 1 Introduction

As Alan Kay stated, *the best way to predict the future is to invent it*. When we use agent-based models for social systems, we always invent a new world, or a new bird-view-like point of view, because we are able to design the simulation world as we would like to. Therefore, when we use agent-based models, we are predicting some future. After several decades of Allan Kay's statements, we have a new tool for predicting the future: Agent-Based Modeling (ABM) is a new modeling paradigm.

ABM shifts the focus from global phenomena to individuals in the model, and tries to observe how individuals, with their individual characteristics or "agents", will behave as a group. The strength of ABM is that it stands between the case studies and mathematical models. It enables us to validate social theories by executing programs, along with description of the subject and strict theoretical development.

In ABM, behaviors and statuses of individual agents are coded into programs by researchers. They also implement information and analytical systems in the environment, so the model itself may be very simple. Even when the number or variety of agents increases, the complexity of simulation descriptions itself will not increase very much. Robert Axelrod [1997a] emphasizes that the goal of agent-based modeling is to enrich our understanding of fundamental processes that may appear in a variety of applications. This requires adhering to the *KISS principle*,

KISS stands for "Keep It Simple, Stupid!" It is a maxim that means: the simpler, the better, and is similar in notion to Occam's razor. Axelrod, who is known for the Iterated Prisoner's Dilemma Game competition, argued as follows in his book [Axelrod 1997a]:

"The two-persons iterated Prisoner's Dilemma is the *E. coli* of the social sciences, allowing a very large variety of studies to be undertaken using a common framework. It has even become a standard paradigm for studying issues in fields as diverse as evolutionary biology and networked computer systems. Its very simplicity has allowed political scientists, economists, sociologists, philosophers, mathematicians, computer scientists, evolutionary biologists, and many others to talk to each other. Indeed, analytic and empirical findings about the Prisoner's Dilemma from one field have often led to insights in other fields."

In the book, he also considers the "Iterated Prisoner's Dilemma Game" as a good model to realize the KISS principle and states as follows:

"Although agent-based modeling employs simulation, it does not aim to provide an accurate representation of a particular empirical application. Instead, the goal of agent-based modeling is to enrich our understanding of fundamental processes that may appear in a variety of applications. This requires adhering to the KISS principle, which stands for the

army slogan 'keep it simple, stupid.' "

This paper discusses the KISS principle assertion once again and presents a new vision on agent-based modeling methodology regarding complex adaptive systems and collective intelligence. This paper is structured as follows: The second section examines agent-based modeling and the KISS principle. The third section identifies requirements for simulation experiment to surpass the KISS principle. The fourth section states how these requirements are reflected in the model, based on our study. The fifth section will give concluding remarks.

## 2 Agent-Based Modeling and the KISS Principle

Traditionally, study of society, economics and systems has approached the theory through cases, in which researchers examine well-structured documents with historical facts or approached mathematical and/or statistical models with some numerical data. For example, financial theorist and engineers utilize concepts of probability and statistics. They often use tools from statistical physics for financial problems. In financial engineering, accordingly, the market is assumed to satisfy certain given conditions like physical laws in the natural world. However such assumptions usually do not hold. That is because the market is affected by decisions and actions of individuals who compose the market, and the trading rules on the market, unlike natural phenomena, are designed based on the decisions of those contained in the market.

On the other hand, study of agent simulation, or more generally agent-based modeling, takes advantage of recent advances in computer's processing power, and shifts the focus from global phenomena to individuals in the model and tries to observe how individuals with their individual characteristics, or "agents" will behave as a group [Deguchi 2000], [Carley 1999], [Carley 2000]. Study on simulation methods in organizational systems has a long history. For example, the book written by Cyert and March [Cyert 1963] is a start point of organizational simulation. Among them, the garbage can model is well-known in organizational decision-making behavior [March 1972]. The strength of the agent simulation approach is that it stands between the case studies and mathematical models. It enables us to validate social theories by executing programs, along with description of the subject and strict theoretical development.

Axtell [Axtell 2000] suggested that agent simulation in social science could extend various aspects, which have been neglected in conventional theoretical studies.

"The simplest use is conceptually quite close to traditional simulation in operations research. This use arises when equations can be formulated that completely describe a social process, and these equations are explicitly soluble, either analytically or numerically. In the former case, the agent model is merely a tool for presenting results; while in the latter it is a novel kind of Monte Carlo analysis. A second, more commonplace

usage of computational agent models arises when mathematical models can be written down but not completely solved. In this case the agent-based model can shed significant light on the solution structure, illustrate dynamical properties of the model, serve to test the dependence of results on parameters and assumptions, and be a source of counter-examples. Finally, there are important classes of problems for which writing down equations is not a useful activity. In such circumstances, resort to agent-based computational models may be the only way available to explore such processes systematically, and constitutes a third distinct usage of such models."

In agent simulation, behaviors and statuses of individual agents are coded into programs by researchers. They also implement information and analytical systems in the environment, so the model itself may be very simple. Even when the number or variety of agents increases, the complexity of simulation descriptions itself will not increase very much. Though they cannot cope with computational complexity or combinatorial explosion in the simulation, agent based models are very effective to analyze complex social phenomena with simple description. We should switch our principles of conventional artificial intelligence approach [Russell1995], which tries to make agents smart, into ones to unravel "intelligence as a group " through agent-based modeling.

Under such agent-based modeling principles, results of scientific study will be

communicated in a form comprehensible to other researchers, and when it involves experiments, the results will be reproducible. Emphasis on the KISS principle in agent simulation is to truthfully respond to these two requirements. Needless to say, agent simulation is merely "understanding" and "execution" of a certain aspect of a phenomenon, but it has the potential to greatly advance the frontier of existing studies when it is used as a supplement to the theory or when theory is used as a supplement to it.

On the other hand, the simpler the model, the more explanatory interpretation of the result is necessary, in order to avoid easy explanation such as "We did it and we got it, " as Izumi mentioned. Actually, several extreme explanations were given to the models discussed in Axelrod [Axelrod 1997a] and Epstein [Epstein 1996]. When the model is simple, the result seems to be obvious, and the harder we try to understand phenomena, the more complex the model becomes, which goes against the KISS principle.

### 3 Requirements for Agent-Based Simulation Experiments

It is necessary to depart from the KISS principle to better understand social phenomena. However, it does not mean that we shall implement unnecessarily complex models to conform to the actual world. Below I summarized the requirements for simulation experiments, especially agent-based simulation of social phenomena.

(1) It should produce results, which correspond with real world phenomena

Unlike natural phenomena, social phenomena are not reproducible. However, there are established theoretical systems to explain phenomena, such as financial engineering and economics. It is important that simulation provide results that agree with these theories and actual phenomena.

(2) It should show phenomena difficult to explain by existing theories

It is also important that phenomena that are difficult to explain by existing theories but exist in reality will be reproduced in a limited manner. For example, the fat tail phenomenon, which is observed in stock price distribution, is difficult to explain by existing theories, but it can easily be reproduced in simulation, and an explanation is provided by economic physics.

(3) It should generate satisfactory results

Simulation study of social phenomena requires numerous parameters. Therefore, we can produce desired results by parameter tuning. Results unsatisfactory to the researchers of model builders are meaningless. Researchers must at least be convincing in the literature regarding simulation results.

(4) The results must be rigorously validated

When a simulation experiment is performed, it produces results. However, it is extremely difficult to demonstrate the validity of the results. The results will lack persuasion without a theory upon the simulation is based, a basis for the functions equipped to the

agents, accuracy of the program, strict sensitivity analysis of the results, and so on.

(5) It should approach the issues difficult to explain by existing theories

Existing theories are based on the assumption that there is some sort of rationality in the agent's behavior or decision making. In actual phenomena, however, this rationality assumption often does not hold. Simulation may provide a systematic explanation for, and reveal hidden conditions of such issues.

In the following chapter I will briefly present recent studies that shows how we have been working to fulfill these requirements. I will use [Takahashi 2002], [Takahashi2003], and [Takahashi 2003] as examples for (1) and (2), [Kurahashi 1999], [Terano 2000a], and [Kurahashi 2001] for (3) and (4), and [Sato 2000], [U-Mart 2003], and [Terano 2003b] for (5).

#### 4 What We Find from Agent-Based Simulation

In the following sub-sections, I will describe several interesting results, which take place in social and economic systems, with focus on research results from ABM we have conducted. The following examples are obtained through systematic validations on simulation results. However, due to restriction of space, I do not detail simulation prerequisites, model architecture, or experiment methods. For details, please see the references.

#### 4.1. Agent Simulation of Behavioral Finance

Understanding the mechanism of the financial market is important to analyze rapid development of e-commerce and the robustness of the economic system. So far, however, such analyses have mostly used macroscopic mathematical models. Conventional financial models are analytical and require ‘rationality’ in the market and individual behaviors. The assumptions of rationality of conventional theories are summarized as follows: (i) that the market is effective and the information will be known to agents immediately and completely, (ii) that agents are capable of decision making that maximizes their utility functions, and (iii) that there is no limitation in the agent’s financial resources, and transaction of any scale is possible. These assumptions are not met in reality, but they are inexplicitly assumed in designing, for example, financial products.

Based on the background, we have developed an agent-based simulation model to evaluate financial market behavior (Fig. 1). We paid attention to the gap between the GARCH (Generalized Autoregressive

Conditional Hetero-scedasticity) model and prospect theory in social psychology, and have examined the influence of the agent’s risk management methods on the financial market [Takahashi 2002], [Takahashi2003], [Takahashi 2003]. Here the GARCH model is a model to explain macro-level phenomena, which presumes the volatility (price dispersion) in financial engineering. On the other hand, the prospect theory is a micro-level model, which explains the nature of human decision making in cognitive psychology, which explains that the loss is estimated as larger than in actual fact. These theories are well-known in finance and cognitive psychology, respectively, and can be combined by the agent-based model to enable macro-level analysis based on micro-level behavior.

In our model we implemented a virtual market composed of four types of (rational and irrational) investors, which is also equipped with two types of risk management methods, VaR (Value at Risk) and portfolio insurance. The market we have developed consists of one thousand investors and allows them to trade two types of assets: a stock and

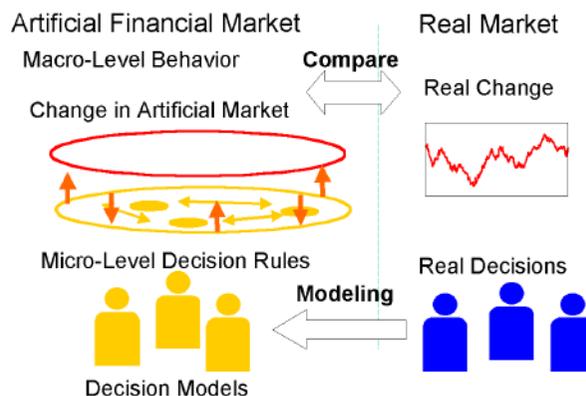


Figure 1. Agent model for the financial market

a risk-free asset. In this market, multiple types of investors exist and conduct transactions based on the investment rules defined for each type. The market operations contain the following three steps: accrual of the corporate profit, formation of the investors' predictions, and determination of the traded price. In the following, we explain in detail, about the trading assets, decision rules of both active and passive investors, and decision procedures of market prices.

Findings from the experiment results are summarized in the following five points: (1) Even when there are a certain number of rational decision making agents in the model, the effective market assumption does not hold; (2) Even when there are rational decision making agents, irrational decision making agents will survive; (3) Behavior of agents with the mental model based on the prospect theory will determine volatility prospect based on the GARCH model. (4) Risk management methods in financial engineering are useful for individual agents. (5) However, in some cases, e.g. when excessive risk management is conducted or when there are investors who care about others, risk management may have a negative influence on the market. These results suggest that irrational investors incessantly have an impact on the price in the actual market as well, and further, indicate the effectiveness of applying agent simulation to the field of finance.

Our model is validated based on the following points: For requirement (1) a typical model in financial engineering and cognitive science is employed for an agent 's micro-level decision making, and well-known results in

the literature are employed for the market. Therefore, the results were conforming to existing theories within the range of 'rationality' on the macro-level. For requirement (2), relaxation of the 'rationality' assumption regarding agents, widens the gap between existing theories and at the same time gave no results conforming to actual data on the macro-level.

#### 4.2. Agent Simulation of Social Interaction

We have been working on an artificial society simulator TRURL, which aims to explore social interaction problems observed in such real-world activities as e-mail-oriented organizations and electronic commerce markets. We used this simulator to (i) analyze the emergence of leadership and conforming behavior in the electronic community [Kurahashi 1999], as well as (ii) analyze the stabilization and breakdown of distribution rules of information resources, which is the foundation to maintain the community [Kurahashi 2001].

TRURL is an artificial society model composed of agents with decision making functions based on the multi-attribute attitude model. This society is characterized by physical distance between agents, confidence distance, and communication attitude, and has a parameter space of the 13th power of 10 to the 15th power of 10. The agent has event-action rules [Russel 1996] and acts consuming the parameter called "participation motivation" (equivalent to the amount of energy or metabolism) during simulation. Furthermore, exchange of "knowledge" changes the agent 's decision making structure

and motivation value.

Decisions of the agents are made based on each agent's knowledge, but independent of this, there is a message exchange process among agents. Each agent interacts with other agents at discrete time steps according to the restrictions set for each simulation model. The interaction is performed according to knowledge attribute. When an agent receives unknown knowledge, it will accept it as is. However, when known knowledge is received, the nature of knowledge will change based on the following attunement behavior rules in accordance with its attribute.

With agent parameters set on the micro-level, the conditions of the society can be measured by macro-level information or social indices such as the speed of change in general social opinion, maldistribution of information goods measured by the Gini index, and the topological scale of the communication network.

In TRURL, the social index is optimized by

Genetic Algorithms. That is, many parameters in the artificial society are adjusted by the evolutionary computation method. At this time, we will use the above social indices to evaluate the society as an objective function, and the resultant convergent society is analyzed from the characteristics of the agent group that composes the society. In the actual social system, these macro indices are measurable, but the system's individual agent characteristics cannot be obtained. On the other hand, in the artificial society, it is possible to create a society with the above-mentioned nature through "evolutionary computation" by using such macro-level measures as objective functions. Furthermore, we can obtain different knowledge by conducting simulation in the created society, and analyze the characteristics of the agents that compose the system based on parameter distribution information. The significance of simulation experiments of an artificial society lies in this point.

We call this method "inverse simulation," because it solves an inverse problem to

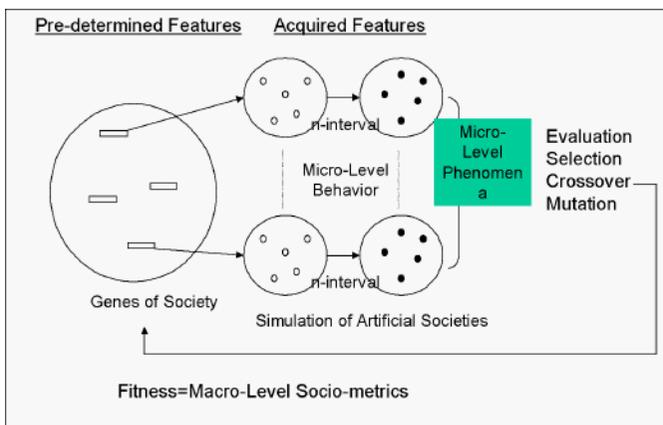


Figure 2. Evolution of the artificial society through inverse simulation

identify agent parameter, and also "genetics-based validation," because it analyzes agent parameters created by genetic algorithms.

Agent simulation models using the artificial society model TRURL are validated based on the following. For requirements mentioned in (3) in the previous chapter, by systemically exploring a sufficiently large parameter space, it achieved the optimum value expressed by the objective function; in other words, it eliminates arbitrariness in parameter-tuning in design and execution of simulation. To address requirement (4), we statistically analyze a lot of individual information; that is, many simulation results to systemically perform sensitivity analysis of the simulation results.

#### 4.3. Participatory Simulation by Mixing Human and Machine Agents

U-Mart is a test bed aimed at examining various problems rooted in the complexity of the economic trading market. Issues at hand include (1) clarifying decision making issues,

including human group 's learning/emergence and interaction regarding behavior of trading stock and so on, as well as system design; (2) clarifying the relationship between speculative trading behavior and market instability such as violent price fluctuations in the market, and designing a system that can prevent it; (3) assuming an agent 's behavior from market conditions, such as testing of use of insider information; and (4) experimenting with coevolution aspects of trading strategy in the market. All of these problems are difficult to discuss by conventional economic theories, and require the approach using agent simulation with some degree of complexity.

To develop the test bed, we set the following three requirements:

(1) ssociation with the real world:

The U-Mart targets the actual stock price index and virtually creates the market that deals not in "spot" but in "futures," which does not exist in reality.

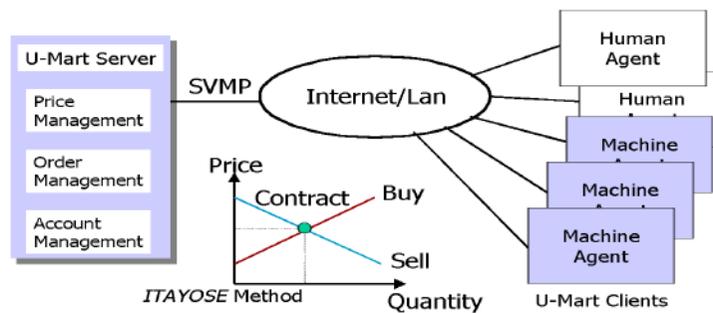


Figure 3. Configuration of the U-Mart system

(2) Openness with wide participatory opportunity: To enable interdisciplinary research among various fields, including economics, financial engineering, and computer science, the system will be designed as an open system that allows participation of various bodies. In the study of artificial market, (limited) rationality and diversity of trading strategy are important. In U-Mart, we explore potentials of various strategies through software agent contest and gaming simulation by human players, and study price formation based on these results.

(3) Provision of the experiment environment for system analysis and design: Virtual experiment of the market under various trading strategies enables anatomical analysis of experiment results. We also evaluate the influence of various systems of the market, such as pricing, settlement, and commission, and handle system design issues.

Fig. 3 shows the architecture of U-Mart system. As shown here, U-Mart is relatively simple as an experiment system. However, our various experiments over three years showed the following interesting phenomena.

(1) In the actual market, small fluctuations of trivial information often trigger violent fluctuations. Similar erratic fluctuations also take place in the U-Mart. Some triggers are incorrect data entry by humans participating in the U-Mart. Similar phenomena are also observed in the real world.

(2) An agent 's performance cannot be determined by a limited number of experiments. Even agents designed to succeed in a transaction may greatly vary in performance, depending on information given or whether they are acting in combination with other agents. Accordingly, a diversified aspect is important for agent evaluation.

(3) Even small changes in trading rules of the market significantly affect agent 's performance. Accordingly, designing a system for a robust market is extremely difficult.

Such knowledge could not be obtained without the simulation environment where software and humans exist at the same time, which corresponds to requirements (5) in the previous chapter.

## 5 Concluding Remarks

In this paper, I have discussed the principle of agent-based modeling and the necessity to go beyond the KISS principle, keeping in mind application to social/economic system study.

The agent simulation method is very powerful as it can produce results without unnatural assumptions, unlike conventional approaches. For this reason, it is also gradually attracting much attention in the field of social science, which has little connection with artificial intelligence study [Epstein 1996], [Deguchi 2000b], [Gilbert 1999]. Furthermore, many simulation tool kits have been released in recent years (e.g. [Ascape

2001], [Swarm 2001], and [MAS 2003]). On the other hand, there has been little persuasive discussion in the traditional social science field, due to beliefs such as that it ignores conventional research hypotheses, or that the basis of the model is too weak to overcome the discussions in the literature. However, agent-based modeling is a very effective approach when considered as the third study method that interpolates the case study approach and mathematical approach.

In recent years, many texts on agent-based modeling have been published in artificial intelligence-related fields as well [Izumi 2003], [Namatame 1998], [Nishida 2002], [Ouchi 2002], [Weiss 1999]. As I have mentioned in this paper, now is the time to call for a new methodology that goes beyond the KISS principle. More recent results and discussions through various lines of study are found in [Terano 2007a] and [Terano 2007b], in which I emphasize the methodology of ABM validations and the needs for continuous improvement on ABM research.

### Notes

(1) Preliminary version of the paper was presented at the 21<sup>st</sup>-Century COE Program Creation of Agent-Based Social Systems Sciences, 2<sup>nd</sup> Symposium on July 12, 13, 2005 at Tokyo Institute of Technology, pp. 69-78 (2005). The symposium is conjunct with AESCS 2005.

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