MANAGING INNOVATION FOR SERVICE THROUGH SYSTEMS CONCEPTS

Ryo Sato
Yasuto Fukunaga
University of Tsukuba　Mitsubishi Research Institute

ABSTRACT

This paper focuses on innovation management for service. After examining and classifying service industries and service activities in firms, possible incorporation of other systems concepts into IA methodology is considered. Then the methodology is applied to commercial e-marketplaces for steel sheet and for food supplies, and to the services of a railroad company and related regional development, both of which are regulated by local governments in Japan.

Keywords: Innovation Architecture, service innovation, business process, systems concept, SSM-IA

1. INNOVATION ARCHITECTURE

Innovation Architecture (IA, for short) is a Knowledge tool for management of Innovation in a firm (Sauber and Tschirky, 2006; Tschirky and Kijima, 2005). IA is conveniently used in the formulation process of innovation strategy. Sauber and Tschirky (2007) shows typical nine cases where action research had been conducted. Since the applied targets are tangible products, service innovation needs some modification on the structure of IA. Furthermore, the soft systems methodology (SSM) (Chekland, 1981, 1990) have some room to make IA effective in practice .

This paper first shows the structure of IA itself in Section 2. Then SSM-IA, a modified IA with SSM will be explains and used in formulation of innovation strategy. In section 3, two examples of application of SSM-IA are shown: e-marketplace for steel sheet and that for food in B2B use. IA for service is then formulated and used in section 4. The impact and role of systems concepts in the service-IA will be discussed shortly in section 5.

2. INNOVATION FORMULATION PROCESS USING INNOVATION ARCHITECTURE

2.1 Innovation Architecture

According to Sauber and Tschirky（2006), Innovation Architecture is explained in this subsection. The IA has two main tasks. The one is to provide a birds-eye view of innovation strategy in a firm. The other is to manage the innovation formulation and reformulation process by using that integrative view.

IA has three dimensions as like an architecture of a physical building. They are called object knowledge, methodological knowledge, and meta knowledge.

(1) Object Knowledge

Knowledge on target object is called object knowledge. It is specific to certain objects under concern. The object knowledge forms the vertical axis of IA. The knowledge has hierarchical structure as Figure 1. It consists of innovation field,

market and market needs, product system and service, module, function, technology (of product, process, or support), applied knowledge, and scientific knowledge. The way that an innovation strategy is represented in an IA shows the depth of a firm on the knowledge on the innovation. It also shows firm's competitiveness on the target product.

market and market need

Market and market needs are most specific knowledge in IA. The opposite is scientific knowledge, and it is most general. Knowledge on market and needs are related to current and latent customers. Market and market needs are grouped into strategic business fields.

product system and module

A product is the final commodity or service that should have a certain competency in market. That is, products and the corresponding market are strongly related. A product is usually composed of modules. If alternative modules have the same interface, then they are compatible each other and different modules can be used in other products. This compatibility allows us to manufacture considerably different products. Further standardization make out sourcing of modules possible. Modularization is an effective form to organize complex products and respective processes.

Technology

Technology is personal and corporate knowledge on product and process, which is explicit or implicit. Its basis is in natural, social, or engineering issues. Product technology deeply related with scientific and engineering disciplines. In order to make certain result available in real life, products performs by fulfilling customers needs in the market. Liquid-crystal technology, for instance, realizes the function of a product that displays data.

Process technology

Process technology decides how to deploy existing technologies. R&D process technology, for example, contains casting, milling, zinc plating, brazing, and so on. Logistics and quality are also included in R&D process. Management process is comprised of the process technology for office automation and building infrastructure as well as security, elevator, and air conditioning..

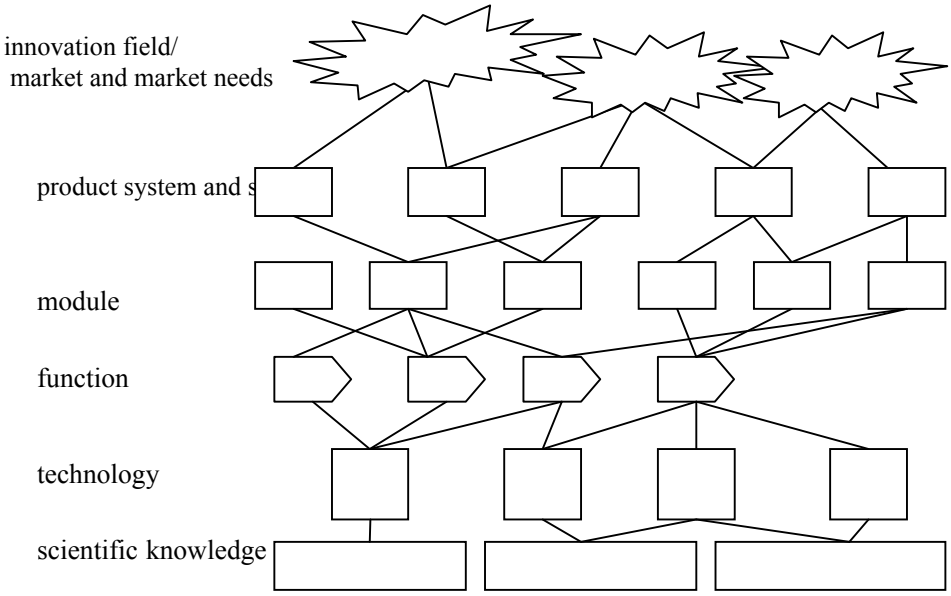

Figure 1. Structure of object knowledge in IA

Function

Function is the description of what this product really does. It can be in detail or in general. Function is, first, to describe how it combines technology into products and modules in value-neutral way. Second, since function is a concept, it allows us to examine possible business areas and new technology platforms. Third, how to describe functions has some effect in the decision on future direction of products. For example, a microwave oven can be a realization of the function to make foods hot, or can be a device to rotate dipole molecules. Either description of function leads a company to remain in food industry or go outside.

Description details

Function composed of main and support functions. A support function can be composed of its support functions. An impact driver is an electric drill. Its main function is to remove material to make a hole while its supporting functions are crashing, separation and take away

Figure 2. Image of impact driver (http://national.jp/myjoy/products/impact_driver/)

In defining function in IA, three guidelines are pointed out:

1) Relate the function to the nature of a product.
2) Relate the function to the perspective of technology that has three level: normative,

strategic, and operational. In the case of a hammer drill, the function can be defined as follows.

normative level: removal of material
strategic level: energy supply; energy conversion; pulling out material
operational level (refinement of support functions): conversion of electric energy to mechanical; conversion of electric energy to vibration.

3) Relate the function to strategic goal and orientation.

Innovation field

In general, innovation field will be defined in wider sense. Instead of mobile phone, mobile communication device is better to be defined. Instead of lacquer and paint, industrial and artificial coating is better.

(2) Methodological Knowledge

In order to make specific description from a level to upper level in IA, knowledge in a firm is needed. this knowledge is called methodological knowledge. The IA shows how a company uses scientific knowledge into technology, and then transform and realize it in the form of product in market. In other words, the resultant IA on a range of products and service represents a company's current status of methodological knowledge.

(3) Meta Knowledge

It is the knowledge of methodological knowledge and methodological knowledge. It is important. But meta knowledge alone cannot be developed.

2.2 Innovation Formulation Process

There are five stages in innovation formulation process: strategic intelligence (information gathering and story formation), identification of strategy, evaluation, decision and formulation, and rollout (Sauber and Tschirky, 2006). We do not go into detail in this paper.

3. INNOVATION STRATEGY FORMATION WITH CONCEPTS IN SOFT SYSTEMS METHODOLOGY

Innovation architecture (IA) is an interactive conceptual tool by which participants for innovation formulation process can show their expertise knowledge in the structural representation of the IA. Objective knowledge and the relations among them are explicitly represented. Even if participants used quite different reference of knowledge, the IA brings a holistic view. In this sense, IA has integrative nature.

In innovation strategy formulation process, participants find necessary objects and suitable representation in ad hoc manner. There are big room for alternative IA, because the formulation process itself is a human activity system (Checkland, 1981). Therefore, the soft systems methodology (SSM, for short) can be incorporated in innovation formulation process with IA.

Outline of SSM-IA

We propose a form of incorporation of SSM and IA (Kamagata, 2006; Sato, Fukunaga and Kamagata, 2006). SSM-IA is depicted in Figure 3. The aim of SSM-IA is to analyze company's service and to try to provide an organized improvement of the service. The characteristics of SSM-IA are as follows.

SSM-IAhas three object knowledge which are not included in the original IA. The

"innovation fields/market and market needs" object knowledge is separated into two. They are target and market needs as shown in Figure 4. This refinement is helpful for us to build the IA. The other modification is "technology." That is important in manufacturing company. For service, operational knowledge is much more important. Thus, "technology" is changed to "technology/operational knowledge."

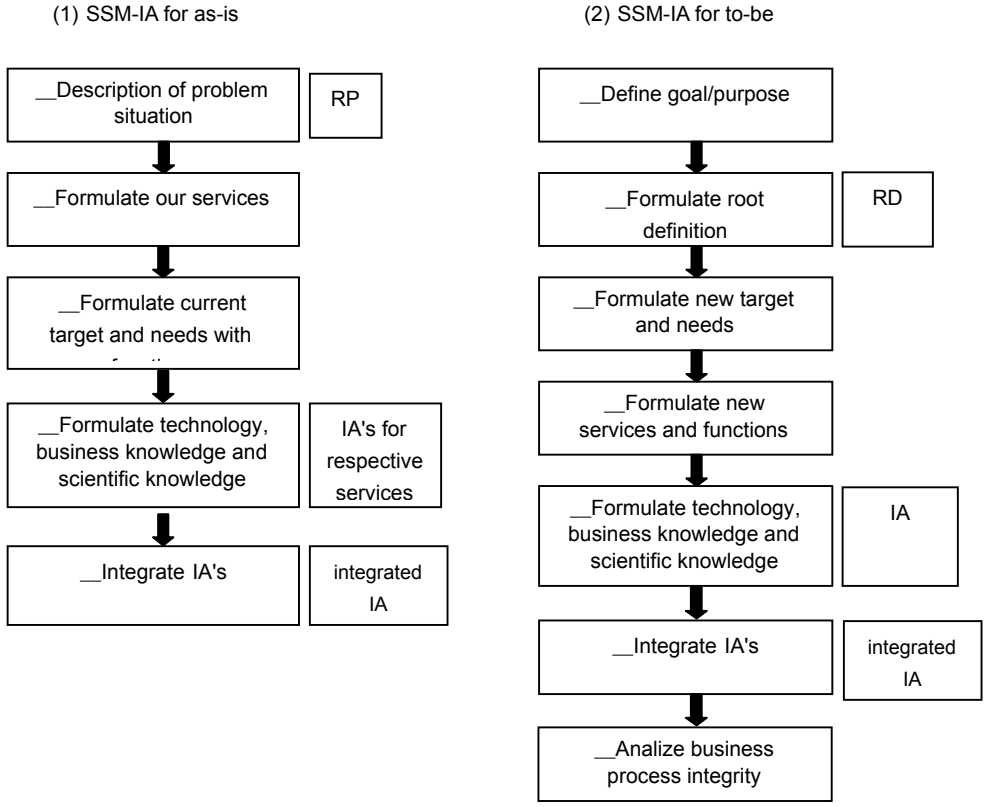

Figure 3. Stages and products in SSM-IA

Use of Root Definition of SSM in Building IA

SSM-IAheavily uses the root definition of soft systems methodology (Checkland, 1985, 1994). Root definition indicates the direction of innovation.

Root definition of SSM should includepurpose(Z), means(X), and activity(Y) as called XYZ analysis. The purpose of service is to provide a transformation process that brings customers some value. This transformation corresponds to fulfillment of market needs in IA. An activity will be executed by a mean in SSM. In IA, the situation is said to use a function for the activity. The concept of CATWOE (C:customer, A:actor, T:transformation, W:weltanshauung, O:owner, E:environment) is also useful.

Figure 5 shows an IA for as-is service of an e-marketplace called FOODS Info Mart at its very early stage.

We show the stages in SSM-IA for to-be services.

Stages in SSM-IA for To-Be Service

Seven stages need to be followed.

Stage 1: Define goal/purpose

Based on the mission of a firm, define general goal/purpose of the services that the

firm is willing to realize.

Stage 2: Formulate root definition

If necessary, refine the services. Then, formulate respective root definitions. As like usual SSM usage, logical and appropriate abstraction will be helpful.

Stage 3: Formulate new target and needs

Based on the root definitions, further discussion will be conducted. Focal point is logical integrity between purpose and root definition. IA's are produced for respective purposed after examination.

Stage 4: Formulate new services and functions

Provide a description of functions that will be supposed to produce required target and needs. give the name to a function so that similar function should be combined into one big function with detailed functions.

Stage 5: Formulate technology, business knowledge and scientific knowledge

Describe possible and necessary technology and businessprocess which is related by function with service.

Stage 6: Integrate IA's

By adding new components of IA defined do far into the integrated IA for as-is service. If necessary or appropriate, some components may be grouped.

Stage 7: Analyze business process integrity

By using resources outside of a company, the formulated business process is checked. Published white papers and books on standards can be referred. Experts inside the company can also be helpful.

3.4 Food e-marketplace

As an example of an IA for to-be, we show the case of a B2B e-marketplace for food. Since one of the authors (Y.F.) has had communicated with the e-marketplace company, called the Infomart Corporation, for long time, some research on the development of the e-marketplace firm had being done from the very early stage of the firm's history. The company is now a quite successful and still spreading its business areas in Japan. Success factors had been analyzed in a way without IA. They are:

- Usage fee is charged as membership, instead of charges on transactions on the site.
- Provision of off-line service (in addition to e-marketplace).
- Continuous improvement triggered by users' needs.

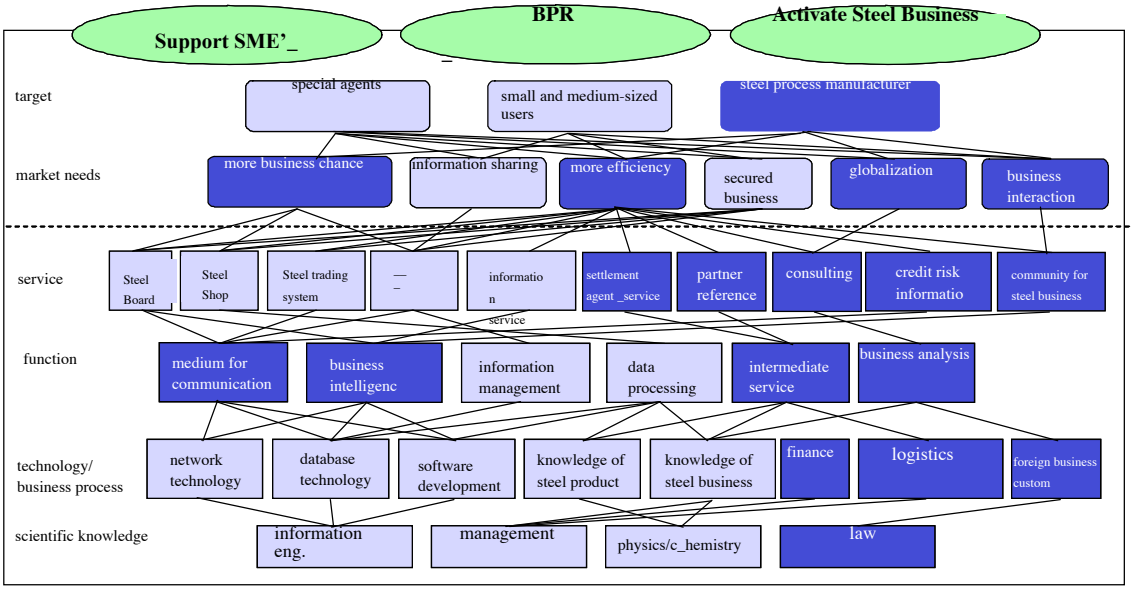

Figure 4. The IA for "supporting SME," "BPR," and "activate steel business."

The aim of making IA for the FOODS Info Mart is to examine whether and how the IA could represent the success factors. As of September 2006, the number of member companies were 13,000 and monthly transaction on the marketplace was 22 billion JPY (ca. 140,000 euro). The membership fee as buyer is (only) 5,000 JPY (ca. 30 euro), remaining at almost the same price from the beginning.

Figure 5 is the IA for as-is for the early stage of the FOODS Info Mart.

Infomart had researched not only market needs but business climate/trend. As for market needs, function of the e-marketplace was refined and implemented. At the same time, employees of Infomart also visited buyers of the e-marketplace, asking, for instance, why you are not interested in certain food and making it feedback to corresponding sellers of the food. One of the other example is screening of sellers for the site. Services on the e-marketplace is not the all. Additional services make the buyers and sellers feel like that it would be a great loss if I do not use the e-marketplace. When we focus on certain service, these kind of additional services are called service conditions. Thus, the bundle of a service and service conditions decides the effectiveness of the service.

Therefore, if IA is used to reinforce consideration of effective bundle services and conditions, then IA for service can be used to differentiate service from other company, and then IA can lead to concrete contents of service. In other words, if IA could not represent effective combination services, the IA will provide a basis of examination and analysis.

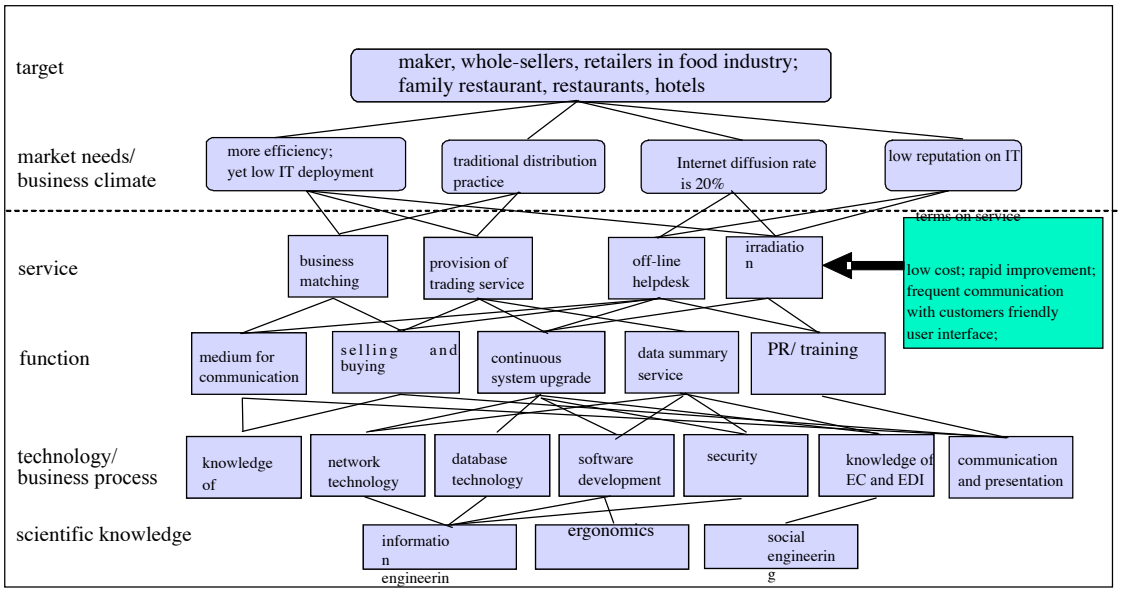

Figure 5. IA for the early stage of Food Info Mart

4 SERVICE SSM-IA

The main source of this section is the research as a master thesis (Iwasaki et.al., 2007) which one of the authors (R.S.) had supervised. We propose the service IA as an improved SSM-IA, by changing object knowledge of IA.

4.1 Service Management

According to Norman (1993), service is personality intensive. It is not labor-intensive or capital-intensive. People usually tend to think service is labor-intensive because, in restaurant, many workers are needed to serve customers. People can also think service is capital-intensive because air line companies have to have air planes and because a railway company should have railways and trains.

Based on the above and other facts, he describes many issues in order to provide a good service. We just pick two of them. First, human provider should cultivate his/her ability about service. Since service has many facets, it is not an easy task. Secondly, when we think about service, we need to focus on the delivery process of service. In delivery process, not only workers but also customers will play some roles. And then, how a customer behave will bounce back somehow what service the customer could get. Norman pointed out that the components of service delivery process are employees, customers, facilities and physical equipments.

In order to improve SSM-IAfor service, we should pay attention on the delivery process, and then add "business process/service infrastructure" to represent service delivery process.

4.2 IA for Service

An objective knowledge is changed, while module is deleted as is shown in Table 1.

Business process refers "the delivery structure of products and service." Business process is modeled as a discrete-event system (Sato and Praehofer, 1997) with its static structure called activity interaction diagram (AID, for short). An AID consists of activities (or, organizations) and connecting data (or, objects) so that it represents the structure of the process. A business process may be explicitly defined or implicitly formed. Service infrastructure is "facilities and equipments with which service will be delivered." Service infrastructure can be hard or soft. Examples of the former includes traffic roads, railways, cars, telephone lines, and the Internet. Soft service infrastructure include capitalism (with democratic election system), laws, data definition of electric data interchange, protocols of SOA(service oriented architecture), and Japanese convenience store franchise.

Table 1. Object knowledge of SSM-IA for service

original IA	SSM-IA	Service SSM-IA
innovation fields/market need	target market needs	target market needs
product/system/service	service	service
module	---	---
function	function	function
technology/application knowledge	technology/ business process	business process/service infrastructure
scientific knowledge	scientific knowledge	scientific knowledge

4.3 Examples of service SSM-IA

Three cases had been studied in Iwasaki et.al. (2007). Table 2 represents the components of an as-is IA for a newly started railway company (named as TX Express). The target service on Table 2 is the very basic service of railway company. Another case focused on reginal development that is related to TX. It was turned out that IA can be used for comparison of regional development policies between local governments.

The service SSM-IA is now being used for the analysis of possible innovation in shipping business and expor and import business, by focusing on material handling, international benchmarking on port logistics, and treaceablity system.

Table 2. Components of As-is IA

Object Knowledge	Corresponding Components
target	passengers of TX railway
market needs	transportation to destination; enrichment of station facility; fare; improved time table; politeness of employees; appropriate regulation to passengers
service	transportation of passengers
function	transportation; safety; comfort; antiterrorism measures; consideration for disabled people
business process/service infrastructure	infrastructure of trains, station facilities, ticket issuing
scientific knowledge	railroad engineering; information engineering; ergonomics; management science

5. CONCLUSION

After explanation of original form of innovation architecture, we have introduced two versions of IA for service. The first one, called SSM-IA, is a kind of amalgamation of SSM and IA. The concept of root definition from SSM can play an important role in formulating service innovation strategy by using IA. When we focus on service, instead of tangible technical product, object knowledge of IA seems to be changed so that business knowledge can be employed.

The second version of IA for service does not use the concept of module, and use the concept of business process and service infrastructure. We are now applying this service SSM-IA to other service centric company.

How are systems concepts used in this research? First, systems concepts of SSM were introduced explicitly into SSM-IA (Sato, 2005). Secondly, as H.A. Simon and T. Yoshida pointed out, soft and social systems like service should have many possible physical implementations. Therefore, they need to be designed.

It is our strong belief that SSM-IA of either version can be used successfully in providing an integrated platform for professional examination and discussion.

Acknowledgement

This research is partly supported by the service innovation group of University of Tsukuba.

REFERENCES

Checkland, P.(1981), *Systems thinking, systems practice*, John Wiley & Sons.

Checkland, C. and Scholes, J. (1990), *Soft systems methodology in action*, Wiley.

FOODS Info Mart(2007), http://www.infomart.co.jp/

Fukunaga, Y., Sato, R. and Kamagata, T.(2006), "Analysis of e-Marketplaces through IA", Proceedings for Annual Conference of Japan Society for Management Information, 376-379.

Iwasaki, K., Shinozuka, A., Simooka, O. CHiba, A., and Terao, A. (2007), " The Concept of Innovation Architecture to Service and It's Application to Tsukuba Express, City Planning, and Public Administration", Master thesis, University of Tsukuba. (in Japanese)

Kamagata, T.(2006) Analysis of Steel e-Marketplace through Soft Systems Methodology, Master thesis, University of Tsukuba. (in Japanese)

KOZAI dot com(2007): .http://www.kouzai.com/.

Norman, R(1991), *Service Management: Strategy and Leadership in Service Business*, John Wiley & Sons.

Sato, R. and Praehofer, H.(1997), A discrete event model of business system - A systems theoretic foundation for information systems analysis: Part 1, IEEE Trans. Syst, Man, Cyber 27-1:1-10.

Sato, R.(2005), "Putting general systems sciences to practical use: Methodological issues, and the case of business process engineering," Proceedings for the Conference of International Federation of Systems Research, Kobe, Japan. CD-ROM.

Sato, R., Fukunaga, Y. and Kamagata, T.(2006), "A study on innovation formulation process with IA for service", Proceedings for Annual Conference of Japan Society for Management Information, 372-375.

Sauber T. and Tschirky H. (2006), Structured Creativity, Palgrave Macmillan.

Tschirky, H et.al.(2003) ed.., *Technology and Innovation Management on the Move*, Orell Fuessli Verlag.

Tschirky, H and Kijima, K.(2005), "Systems Meet Innovation Management," Seminar hand-out, Tokyo Institute of Technology, autumn.

Simon, H.A.(1981), *The science of Artificial*, 2nd ed. MIT Press.

Yoshida, T. (2005), "The second scientific revolution in capital letters - informatic turn", Proceedings for the Conference of International Federation of Systems Research, Kobe, Japan. CD-ROM.