Regular Paper

A New Systems Engineering Approach for a Socio-Critical System: A Case Study of Claims-Payment Failures of Japan's Insurance Industry

Toshiyuki Yasui*

Graduate School of System Design and Management, Keio University, 4-1-1 Hiyoshi, Kohoku-ku, Yokohama 223-8526, Japan

Received 3 September 2009; Revised 9 November 2010; Accepted 9 November 2010, after one or more revisions
Published online 16 February 2011 in Wiley Online Library (wileyonlinelibrary.com).
DOI 10.1002/sys.20183

ABSTRACT

Since the 1950s there have been numerous contributions proposing solutions to failures of social systems. However, we have hardly found a holistic and interdisciplinary approach to a failed social system beyond "stove-piped" academic disciplines. This paper identifies a new holistic and interdisciplinary systems engineering methodology of systems engineering for a social system through a case study of Japan's insurance industry. The new methodology is a "soft" systems-approach to accommodate goals of stakeholders in a failed social system. First, the three elements of a social system are identified. Second, the multiple viewpoint model transforms these three elements of the human activity view to a new set of elements of the H*olon* view. Third, a social system of the H*olon* view is redefined as a S*ocio-Critical System* (SCS). Finally, the Vee Model is applied for fixing a problem in the SCS. From 2005 to 2008, massive claims-payment failures cases were found in Japan's private insurance companies. They became big social scandals. The insurance claims-payment system is a typical SCS. The Financial Services Agency (FSA), Japan's financial services supervision authority, identified, with the "unintended" systems approach, dysfunctions of the insurance claims-payment system. This FSA action, even though the authority was not aware of the effectiveness of the methodology, proved to be positive in applying the Vee Model for solving failures in those claims-payment systems. © 2011 Wiley Periodicals, Inc. Syst Eng 14:349–363, 2011

Key words: Socio-Critical System; Holon; Vee Model; claims-payment system; Financial Services Agency; systems approach

1. INTRODUCTION

1.1. The Problem

From the year 2005 to 2008, it turned out that more than 30 Japanese insurance companies failed to pay proper insurance claims to policyholders. Such failures were judged as a clear violation of the insurance business law of Japan. They showed serious deficiencies in internal control and governance in insurance companies. The Financial Services Agency (FSA), the financial authority of Japan, implemented full-scale inspections and took administrative action in those cases.

* E-mail: t.yasui@z2.keio.jp

Table I. Payment Failures of Japan's Private Insurance Companies: 1.86 Million Cases with Unpaid US$1.5 Billion (2005–2008)

Life Insurance Companies: Unlawful Refusal to Pay Claims *(Hutekisetsu-Hubarai)*	1,488 cases	JPY 7.2 billion (US$ 758 million)
Life Insurance Companies: Payment Leakage with System and/or Governance Failures *(Shiharai-more)* and Negligence to Invite Policyholder to Apply for Other Benefits *(Seikyu-Annai-More)*	1,350 thousand cases	JPY 97.3 billion (US$ 1 trillion 242 million)
General Insurance Companies: Payment Leakage with System and/or Governance Failures *(Shiharai-more)*	500 thousand cases	JPY 38.2 billion (US$ 4,021 million)
General Insurance Companies: The Third Sector Insurance (Disease and Injury Insurance) Unlawful Refusal to Pay Claims *(Hutekisetsu-Hubarai)*	5,760 cases	JPY 1.6 billion (US$ 168 million)

This misconduct included (a) a company's intentional and unlawful refusal to pay claims to a policyholder (*Hutekisetsu-Hubarai*), (b) a company's payment leakage with claim-payment system failure and/or wrong check flows (*Shiharai-More*), and (c) a company's negligence in not inviting its policyholder to apply for another benefit–payment request, although such a policyholder could have been simultaneously paid if he/she had done so (*Seikyu-Annai-More*).

According to the FSA's successive findings, such nonpayments or payment leakages reached 1.86 million cases amounting to JPY 144.3 billion (roughly $1.5 billion) (see Table I). This problem became a big social issue in Japan. The

Table II. Development of No Claim-Payment and Payment Leakage Cases of Japan's Insurance Companies and Administrative Response to Them

Life Insurance Company	General Insurance Company	Solicitation
[2005] Feb.25: BSO to Meiji-Yasuda Life. July 26: RO to all companies about no claim-payment cases. Oct.2: Result announced on the above RO and BSO to Meiji-Yasuda Life	Sep. 30: RO to all companies on payment-leakage cases of collateral benefit of automotive insurance. Nov. 25: BIO to 26 companies on the above cases.	
[2006] June 2: AD on Payment Control System is revised. July 26: BIO to Nippon Life.	May 25: BSO to Sompo-Japan. June 2: AD on Payment Control System is revised. June 21: BSO to Mitsui-Sumitomo Fire & Marine. July 14: RO to all companies on Third Sector Product. Aug.11: Order to re-examine collateral benefit cases to 26 companies. Nov.17: RO on the dates to complete surveys to 26 companies on collateral benefit cases	Feb.28: AD is revised to introduce contract-summary, alert-information sheet.
[2007] Feb.1: RO to all companies on claim-payment status. Dec.7: all companies completed surveys on the above cases.	Mar. 14: BSO to 6 companies and BIO to 10 companies on Third Sector Product.	Feb.22: AD is revised to introduce customer-needs confirmation letter system. July 5: AD is revised to enhance comparative advertisement.
[2008] July 3: BIO to 10 companies and official request to Life Insurance Association of Japan as well as all companies on the above cases		

BSO: Business Suspension Order, BIO: Business Improvement Order, RO: Reporting Order. AD: FSA's Administrative Guideline for Insurance Companies

evidence collected by the FSA through a series of mandatory reporting orders show that these serious failures in the claims payment system stemmed from the companies' deficiencies in internal control and governance. Consequently, the FSA issued 11 business suspension orders and 54 business improvement orders to fix those system failures. The insurance companies received those orders without any appeals, and they duly submitted their business improvement plans required by these administrative orders. In the plans they committed to improvement of their entire system and business flow from solicitation of insurance products to payment of claims (see Table II).

The insurance companies' business flow from solicitation, preserving customer information, to claim-payment in an insurance company is one of the critical social systems which should never be allowed to fail. However, there is no methodology of systems-approach for problems in a social system if such a system failure occurs.

This paper will develop a standard systems-approach to solve the failure of social systems by a set of systems engineering tools. We will validate that methodology by identifying whether the FSA's actions to no-claim-payment and payment-leakage cases were adequate to solve the problem.

2. PREVIOUS STUDIES ABOUT A SOCIAL SYSTEM

A large volume of academic contributions have been made to apply methods of systems engineering and systems thinking to solve a problem in society since 1950s.

Social systems accounting became major products to analyze social conditions through the 1960s and 1970s [Dunn, 2007: 282–284]. There are many analyses of failed social systems that propose solutions in each discipline of social sciences by inputs from system engineering and policy analysis. For example, Nadler [1987] and Rouse [1987] proposed standard methods to solve systems-failures beyond traditional sense of systems engineering. In the field of the political science and the economics, a series of studies is made to apply the theory of collective learning in complex adaptive systems in considering the complexity and uncertainty of a social system [Wilson, 2001: 340-351]. There is a proposal to define the socioecological system framework for analysis on the core relations in a social dilemma [Poteete, Janssen, and Ostrom, 2010: 235]. Nonetheless, hardly we have observed a holistic and interdisciplinary approach, beyond "stove-piped" academic disciplines to propose a solution to a failed social system.

Among those studies, Peter Checkland is the earliest scholar who included the concept of a social system into the systems engineering methodology by a holistic and interdisciplinary approach. Nonetheless, Checkland treated the social system as an auxiliary component in his methodology [Checkland and Scholes, 1990: 27–31]. There has not existed a methodology to apply a systems-thinking approach to consider a social system itself.

3. DEFINING PRAGMATIC APPROACH FOR A SOCIAL SYSTEM.

3.1. Constraints of Previous Methodologies Dealing with a Social System

When we closely examined theories of social systems in previous studies, we quickly noticed that these theories could not be sources of the systems engineering approach beyond the "stove-piped" academic disciplines of social sciences. For example, sociology categorizes social systems into various subsystems, and it identifies elements of subsystems. But no methodology has been set to solve problems in those systems [e.g., Parsons, 1951, 1967]. Political science *a priori* applies the term "social system" to the political process [e.g., Easton, 1965]. It does not verify the rationale why every political action deserves to be treated as input and output of a social system. For economics, a social system can be the subject to study only if authors extend the scope of the study beyond economics [e.g., Boulding, 1968].

3.2. The Need of a New Systems Approach

Therefore, it is necessary to propose a new systems approach in holistic and interdisciplinary manner to deal with problems in a social system beyond early theories. We come back again to Peter Checkland. Checkland and Scholes [1990] proposed the Soft Systems Methodology (SSM), a new systems-approach theory, to substitute the conventional "hard" systems engineering tools to deal with the problems of social systems.

However, Checkland's methodology has major constraints if we want to apply that to a social system as a systems engineering tool because most of the current systems engineering methodologies should be categorized as "hard" ones according to Checkland's labeling. By contrast, he raised the concept of the SSM on the denial of the effectiveness of the hard-systems approach. So leaving from the SSM, it is appropriate to repeat procedure of the systems approach to consider what elements a social system has. Indeed, Checkland and Scholes have stated, "Neither is a study of the problem situation as a 'social system,' using that phrase in its everyday language sense" [Checkland and Scholes, 1990: 48].

3.3. The Systems Approach of a Social System

The systems approach is defined as successive steps as follows [Jackson, 2010: 29–30; Jackson, Hitchins, and Eisner, 2010: 41–43]: (1) identification of the elements of a system; (2) division of elements into smaller elements; (3) grouping of elements; (4) identification of the boundary of a system; (5) identification of the function of each element; (6) identification of the interactions among the elements; (7) definition of the system's environment; (8) identification of the emergent properties of the system.

For convenience, we will regroup these eight steps into three phases. The first phase is about the elements of a social system. The second phase is about the boundary and the environment of a social system. And the third phase is about the emergent properties of a social system. These three phases are discussed below.

3.3.1. The Elements of a Social System

The elements of a system may consist of hardware, software, humans, processes, a conceptual idea, or any combination of these [Jackson, Hitchins, and Eisner, 2010: 41].

A social system has three elements; roles, norms, and values. These three elements interactively define each other and change to redefine others [Checkland and Scholes, 1990: 48–50]. Roles can have various social positions as their smaller elements. Norms are behaviors in public expected by roles, and categorized into smaller elements as socially expected behaviors. Values are internal or external judgments in a system to select an action for the society. These elements define themselves. The grouping of these elements should be identical, and three elements together compose one social system (see Fig. 1).

3.3.2. The Boundary and the Environment of a Social System

The boundary of a system is the border delineating the inside of the system from the outside of the system. The outside of the system is called the environment of the system [Jackson, Hitchins, and Eisner, 2010: 42].

The boundary of a social system is usually recognized as external factors other than social events. Checkland [1981] defined a social system as mixture of a human activity system and a designed system, and excluded a natural system from it. This concept is consistent with Luhmann's theory about a social system [Luhman, 1984]. In that theory Luhmann identified human communication as the sole element of a social system. The boundary of a social system is thus identified as human communication. With this identification of the social system's boundary, any interfaces between external systems (e.g., a natural system, an artificial system) and a social system in the form of human communications are recognized as the external environment for the social system.

3.3.3. Identification of the Emergent Properties of the System

Emergent properties of a system are the properties of the whole that are not exclusively attributable to any of the interacting parts, which is meaningless in the language appropriate at the level of those interacting parts [Jackson, Hitchins, and Eisner, 2010: 43].

It is obvious that a social system defined here has emergent properties because three elements of a social system, roles, norms, and values interactively define each other within a social system and give feedback to external environments. A single set of these elements can assure functions of a social system.

3.4. Multiple-View Approach To Develop a New Systems Approach

Some of the current systems engineering standards adopt a multiple-viewpoint approach to describe elements and subelements of a system. For example, the IEEE1220 and the ANSI/EIA632 specify the viewpoint for technical systems. They also adopt layered viewpoints models [Shirasaka, 2009: 1–2].

For system thinking for a social system, we can also consider a layered viewpoint model for a social system (see Fig. 2). Checkland [1981] considered a social system from a perspective of human activities. So we define a social system as a system viewed by the human activity view. A social system, as Checkland identified, has three elements: role, norm, and value.

Our next step is to consider what essential subfunction supports the human activity. Checkland paid attention to the layered structure of human activity in society. Checkland considered that this layered structure was essential to equip human activities with emergent properties. He named it the *Holon* [Checkland and Scholes, 1990: 22–23].

Accordingly, we vertically put the human activity view and the Holon view under it. Then we examine what three elements of a social system on the human activity view are transformed in the Holon view. The objective of this transformation is to redesign elements of a social system to more socially focused elements, and finally to make these suitable for a systems engineering approach.

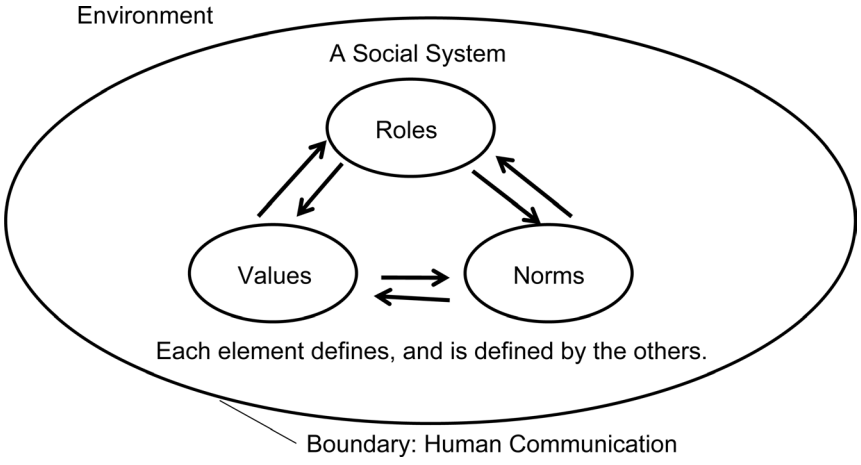

Figure 1. Three elements of a social system. (Source: Adapted from Checkland and Scholes [1990: 49, Figure 2.15]).

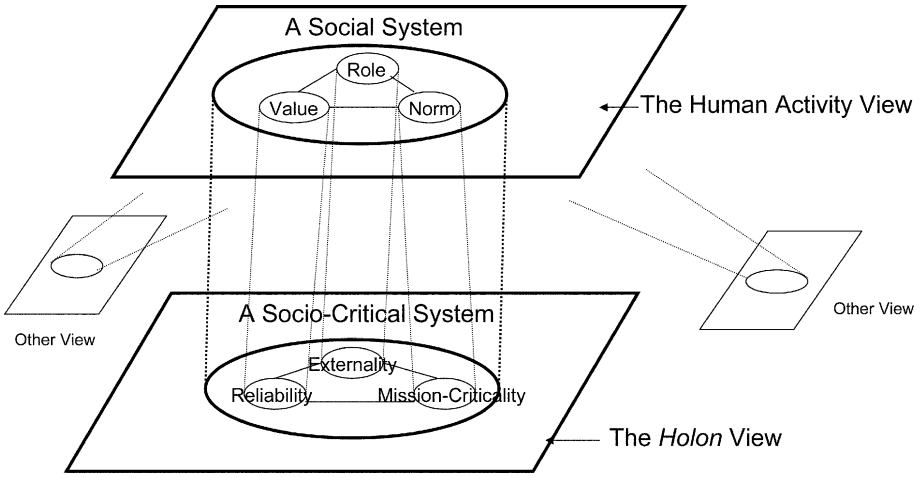

Figure 2. A social system and the human-activity view, a socio-critical system and the Holon view.

This transformation work starting from Checkland's definition of social system elements corresponds to dividing elements into smaller elements with the hierarchal view. The hierarchal view reduces the perception of complication and complexity, and thus allows complexity to be contained, encapsulated, and concealed [Jackson, Hitchins, and Eisner, 2010: 42]. By dividing the elements of a social system in the human activity view into the smaller elements of a socio-critical system in the Holon view, we are able to encapsulate the whole interaction of social system elements into human-activity-centric interactions. Checkland's three elements of a social system are interactions on the human activity view as he defined. So we have to contain, encapsulate, and conceal those interactions by taking the Holon view, the more human-activity-centric view.

3.5. Three Elements of the Socio-Critical System

Three elements of a social system, role, norm and value, are transformed as (a) externality, (b) mission criticality, and (c) reliability on the Holon view, respectively. The Holon means "the constructed abstract wholes" [Checkland and Scholes, 1990: 26]. This term points to the human-to-human interfaces in a social system.

3.5.1. Externality

The term "role" in the human activity view is translated to the term "externality" in the Holon view. Roles of human activity are interactively determined and not separable in human-to-human interfaces (e.g., Luhmann's "the double-contingency problem"). The term "externality" is used to indicate relevant impacts on goods or states of nature that are not traded or tradable in a market, and for which therefore the usual methods of economic valuation cannot be applied [Sage and Rouse, 2009: 1068]. The element "role" of a social system is encapsulated to the element "externality" of a SCS with the multiple viewpoint model from the human activity view to the Holon view. This is because essential role of a social system is invaluable human relations, which is uncountable in economic or financial terms.

This element is to judge whether the failure of a social system adversely impacts society on a large scale and whether its improvement equally and commonly benefits society. If a social system has externality, a system designer is considered to be only a proposer to fix a problem. Usually there is no stakeholders' governance in accordance with the representation hypothesis.

3.5.2. Mission Criticality

The term "norm" in the human activity view is translated to the term "mission criticality" in the Holon view. In human-to-human interfaces, the more important a system is, the more it is required to perform a critical mission. The term "norm" is often used as a "normative scenario" in the situation assessment. The normative scenario describes how the stakeholders want the system to be in the future [Sage and Armstrong, 2000: 90]. Accordingly, we can interpret that the element "norm" of a social system implies how we want a social system to be. The most critical requirement that we want to a socio-critical system is that the system will work without any disruptions. In this sense, with the multiple viewpoint model from the human activity view to the Holon view, the element "norm" is transformed to the element "mission critically."

This element is to judge whether a social system is required to uninterruptedly perform for a socially important mission.

3.5.3. Reliability

The term "value" in the human activity view is translated to the term "reliability" in the Holon view. In human-to-human interfaces, a social system is required to provide confidence to stakeholders if a social system creates some values to society. The term "value" usually consists in systems engineering of four facets: quality, service, cost, and cycle time [Sage and Rouse, 2009: 846]. The value of a social system is heavily measured by its net quality for the society. If this net social quality is transformed with the multiple viewpoint model to the human centric view, it becomes reliability. This is because the social value of a system is endorsed by reliability to the system. Reliability is a basic capability that a system should have [Jackson, 2010: 148].

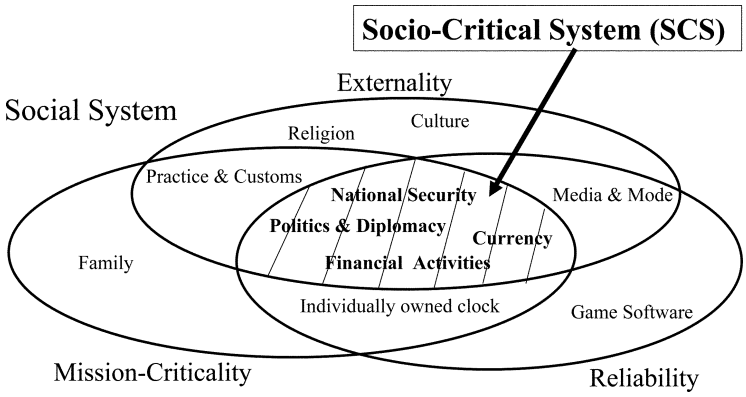

Figure 3. Three elements of a socio-critical system**.**

This element is to judge whether a social system has technical aspects that are reliable and trustworthy. Reliability is usually assured by a successful configuration of both human and mechanical components.

3.6. The Socio-Critical System

A human-centric system in society, which has externality, mission criticality, and reliability, is one which may adversely influence society if it fails. We name a social system containing these three elements a Socio-Critical System (SCS) (see Fig. 3).

In the case of a SCS failure, the government usually intervenes to fix the problem. The SCS is often considered to be in the public good. The scope of SCS coincides with the traditional domain of public policy.

4. APPLYING THE VEE MODEL TO SCS

4.1. Typical SCSs

Human-centric systems, for example, a national security system, an international currency system, and other large-scale and complex social systems, typically represent SCS. They generally contains the three elements of the Holon view: externality, mission critically, and reliability.

4.2. Six Steps of the Vee Model

Forsberg, Mooz, and Cotterman [2005] suggest that the Vee Model is the efficient systems engineering tool for dealing with a large-scale system.

The Vee Model is conventionally considered as one of "hard" systems approach often used for systems designs for aerospace projects. Checkland's hard/soft dichotomy labels the Vee Model as "hard," because the Vee Model takes a problem-solving approach. Chekland and Scholes defined the dichotomy as "the 'hard' tradition taking the world to be systemic; the 'soft' tradition creates the process of enquiry as a system" [Checkland and Scholes, 1990: 25].

This traditional labeling is distracting. The Vee Model should be identified rather as a "soft" approach. When we apply the Vee Model with architecture adjustment and iteration to solve a failure of SCS, the Vee Model can be used to process inquiries for sharing goals.

The Vee Model is normally used for a large-scale, but not complex system. A system is complex when we cannot understand it through simple cause-and-effect relations [Sage and Rouse, 2009: 1186]. An aerospace project is a typical example of large-scale but not complex system because we can predict an outcome of the system despite relations among components that are perplexed. By contrast, a social system is complex in the sense that its emergence cannot be predicted as simple cause-and-effect relations. In this point, the Vee Model has merit by its process to allow architecture adjustment and iteration until the desired emergent properties of a system are achieved. This flexible adjustment and iteration makes the Vee Model suitable to a social system problem.

To accommodate the goal among a system designer, problem owners, and stakeholders, the Vee Model prepares six stages. These six stages are the benchmarks commonly shared by a system designer, problem owners, and stakeholders for system improvement (see Fig. 4):

a. Recognizing a failure
b. Identifying where and what kind of failure
c. Grasping the total system structure and analyzing the system requirement
d. Modeling and proposing a solution
e. Verifying or validating a solution
f. Implementing or revoking a solution.

These steps are the standardized process of enquiries interactively made among a system designer, a problem owner, and stakeholders. The Vee Model has a feature to take a systemic approach both to identify and to design systems requirements. The Vee Model also has emergence by itself when it is applied with modeling adjustment and iteration. It is an undividable set of processes for inquiry to make accommodations among various stakeholders on an ill-defined problem.

The six stages of the Vee Model as the soft methodology are described as follows.

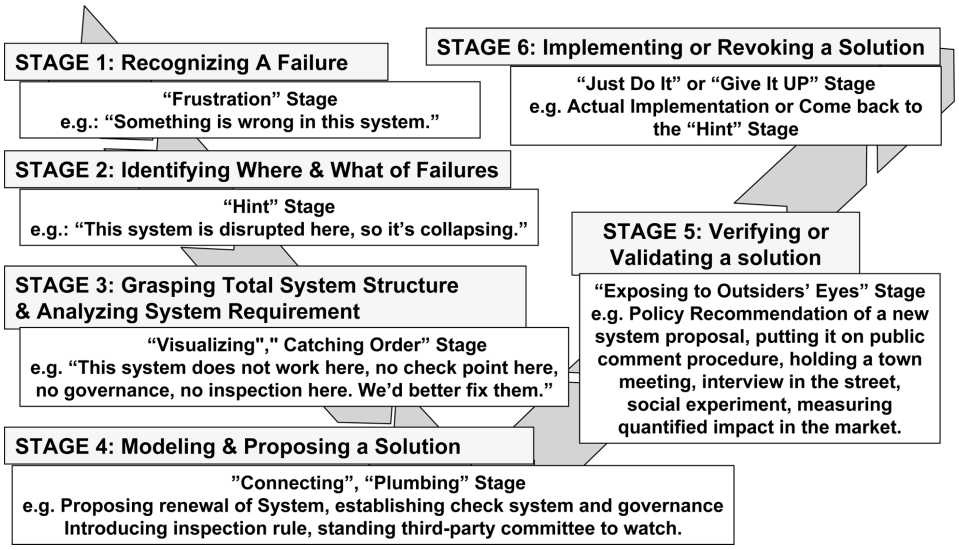

Figure 4. Applying the Vee Model to a Socio-Critical System: six stages**.**

4.2.1. Recognizing a Failure

At this stage a problem is opaquely sensed in an SCS. Some may feel frustrated with the system, and this can be the start of all that follows. At this stage stakeholders and their objectives are ill-defined.

4.2.2. Identifying Where and What Kind of Failures

At this stage a large search is conducted to identify the gravity and scope of system failures. It can be called the "Hint Stage." This stage clarifies differences of objectives and goals which identified stakeholders have, and those differences are made visionary to be put in dialogues among a system designer, a problem owner, and stakeholders.

4.2.3. Grasping the Total System Structure and Analyzing the System Requirement

At this stage, the focus is put on visualizing system failures and structural deficiencies. The requirement is to restructure the SCS to satisfy its three elements; externality, mission criticality, and reliability.

4.2.4. Modeling and Proposing a Solution

At this stage, a modeling or proposal is made to renew the system for improvement. It can be called the "Connecting" or "Plumbing" Stage.

4.2.5. Verifying or Validating a Solution

At this stage, instead of verifying or validating the process of traditional system engineering, a model or proposal is presented to a third party. SCS which is actually at work in society can hardly be experimented with for verification or validation. Therefore, policy recommendations, a public comments procedure, town meetings, and interviews in the street are often used instead of traditional ways to verify and validate. We can interpret that through these public processes a system designer can verify or validate a solution prior to implementation. After implementation there needs to be an orthodox verification or validation to see whether the implemented solution worked or not.

Although the three elements of SCS are hard to measure, some quantitative and/or qualitative validation methods are often used as proxies to express the performance of alternative solutions.

4.2.6. Implementing or Revoking a Solution

This stage is to actually implement a solution. If that solution does not satisfy the previous stages with a poor evaluation of performance, the SCS improvement process reverts to the first stage. This iteration of six stages will continue until the desired emergent properties of the system in consideration come out.

4.3. The SSM and the Vee Model

The Vee Model is better defined as a soft systems approach. Nonetheless, the Vee Model differs from the SSM only at one point. The Vee Model includes social and cultural contexts into one picture for analyzing problems. But the SSM uses a separate set of analysis for these contexts as the root definitions of relevant systems.

4.4. The SCS and the Vee Model

The flexible decomposition and integration at multiple layers is a dominant characteristic of the Vee Model [Forsberg, Mooz, and Cotterman, 2005: 108–116]. The Vee Model has the structure of decomposition downward and integration upward with flexible project flows. It also allows iteration of the whole processes until the optimal outcome is achieved. At this point, the Vee Model is the most suitable model to address a complex system, the project outcome of which we cannot predict.

An SCS, the most human-centric system among social systems, is the most complex system as we cannot predict emergence of systems properties. The Vee Model is applied

to an SCS with iteration until we get the desired emergence of SCS. The Vee Model allows having several levels of decomposition [Forsberg, Mooz, and Cotterman, 2005: 109]. By climbing up one level higher of decomposition level after adjusting the parts and their interactions at one level, emergence of the SCS may be observed and measured [Jackson, Hichins, and Eisner, 2010: 43].

5. APPLYING THE VEE MODEL TO CLAIM-PAYMENT SYSTEM FAILURES

5.1. Claim-Payment System and the Layered Viewpoint Model

The claim-payment system of an insurance company is a typical social system. It is not purely a technical system just to pay claims to policyholders. For an insurance company, all interfaces with customers constitute a human activity system for future claims payments. For example:

- Solicitation of insurance products with a proper explanation of the contract
- Maintenance of the contract and appropriate revision of customer information
- Mechanism to examine a customer's request to pay claims.

The claim-payment system of an insurance company consists of hardware, software, humans, processes, and these combinations. It is not limited to the hardware and software of client data and payment machines. As processes, it includes all human interactions of company employees and clients from product development: solicitation, client data maintenance, claims requests, claims payment examination, and finally actual payment. The claim-payment system is operated to properly pay claims upon request as contracted. For this objective, the system needs clients' knowledge of terms and conditions of the policy and administrative adequacy of an insurance company. Since the claim-payment system is a typical human-activity-centric system, the claim-payment system is one of the social systems, and thus the layered viewpoint model that we discussed in subsection 3.4 is applicable.

Figure 5 is the actual application of the layered viewpoint model for the claims-payment system. The claims-payment system has three elements as a social system in the human activity view: "insurer" for role, "pay claims correctly" for norm, and "confidence-provider" for value.

In the Holon view, a claims-payment system is redefined as a Socio-Critical System. In this view, the "role/insurer" is translated to "externality/public goods"; the "norm/pay claims correctly" is translated to "mission-criticality/undisrupted payments"; and the "value/confidence-provider" is translated to "reliability/assure confidence to a policy-holder" (see Fig. 5).

The system has externality. The modern market economy largely relies on insurance coverage. The modern insurance system relies on the law of large numbers. It means that a large number of policyholders equally consist of the same payment group.

The system requires mission criticality. If an accident happens to a policyholder, the claim and benefit should be paid without any disruptions. If system failures result in nonpayment to policy holders, considerable confidence will be lost in the insurance system. And it may trigger major social unrest. This is exactly that we observed in Japan from 2005 to 2008.

A modern insurance company operates a claims-payment system with visible and accumulated technologies on its business infrastructure. This infrastructure and related human operations are keys to ensuring the reliability of the system.

5.2. System Requirements

To function in the public good, ensuring undisrupted payments and assuring confidence to policy holders are the client requirements for the claims-payment system.

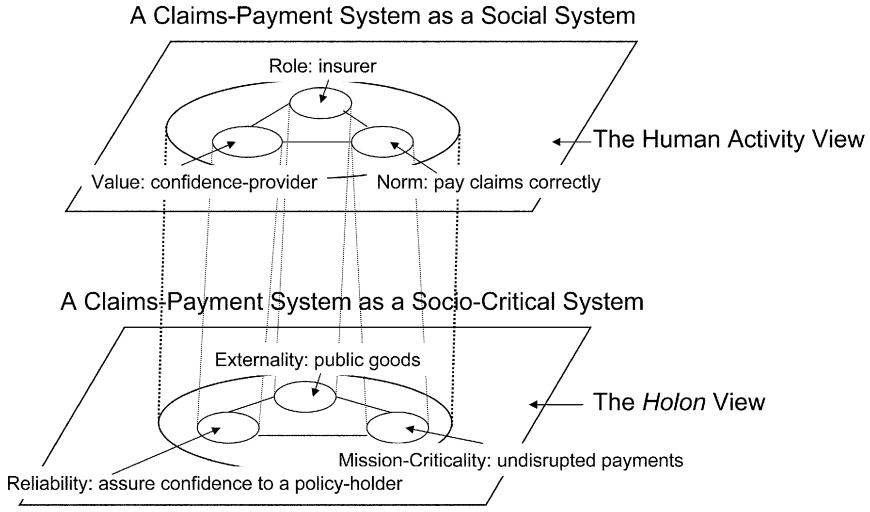

Figure 5. The claims-payments system and its layered elements.

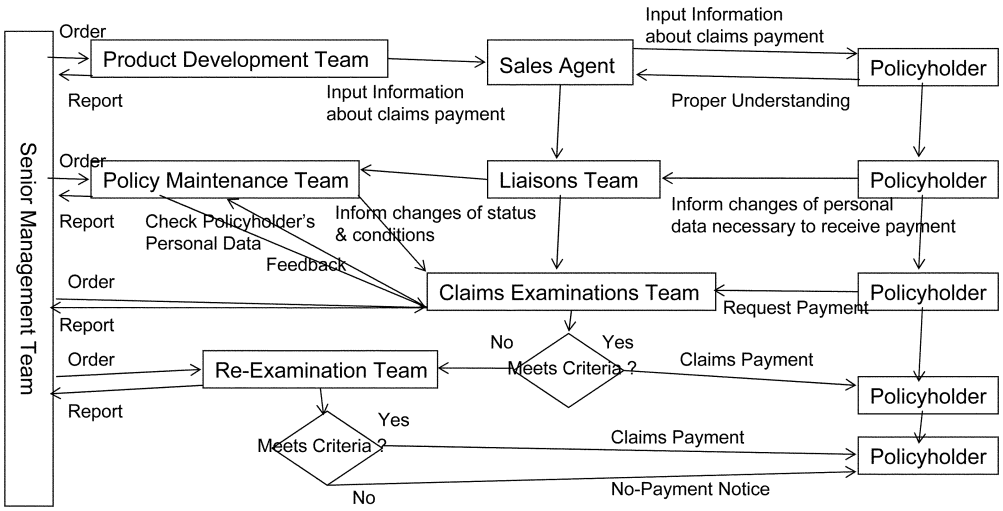

Figure 6. Rough functional diagram of an insurance claims-payment system.

An insurance company makes every effort in daily operations to meet these requirements. They are the most basic functions of an insurance company.

The claims-payment system of an insurance company is a long chain of business flows from policy contract, maintenance and revision of contract information, to final claims payment. Figure 6 is a rough functional diagram of the claims-payment system.

The claims-payment system of an insurance company is a human-centric system composed of successive human interfaces:

- Development of insurance products
- Solicitations of those products
- Contracting with policyholders an insurance policy
- Maintenance and change of policyholders' personal data necessary for the future payment
- Examine eligibility for the future payment upon request from policyholders of such claims
- Actual payment and possible reexamination for an appeal for a no-payment decision.

Figure 7 shows that the top function of the system (a policyholder correctly receives payment) can be divided into sublayers of functions diversified among those of a policyholder, as well as a product development team, a sales agent, a claim examination team, a reexamination team, a liaisons team, and a senior management team of an insurance company.

5.3. Actual Case with the FSA and the Insurance Industry

5.3.1. Systems-Approach To Identify Elements of Nonpayments

The usual business flow of a private insurance company consists of a long process chain from soliciting and contracting to maintenance of contract to payments for claims. The FSA in 2005 came to know of a massive number of nonpayment cases, but it did not know at first sight what caused these misconducts. Many policy holders complained both to the FSA and to the insurance companies. The customers' requirements were obviously unsatisfied.

The FAS started its investigation into nonpayment cases. It identified dysfunctional elements of a payment system with intensive dialogues with the problem owners and the stakeholders in the insurance industry. Dysfunctional elements were scattered around the claim-payments system. The FSA extended the accommodation to share the common goal for the government and the industry: to stop nonpayments. The FSA then identified major leverage points to restore the system's functions. They are as follows (see Fig. 8):

- An insurance company did not provide proper product information to a policyholder. A policyholder did not have the knowledge to request a payment even if the terms and conditions of the contracted product satisfied such a request.
- A policyholder's information essential to enable payment was not updated in an insurance company's customer database.
- There was no reexamination team in an insurance company to respond to a policyholder's appeal after that policyholder receive a no-payment notice from an initial examination team.
- The senior management team of an insurance company was not aware of these dysfunctions and therefore did not exert governance on related sections.

5.3.2. The AS-IS and the TO-BE Models of an Insurance Payment System

The FSA had successive dialogues for accommodation with the insurance industry on the nonpayment issue from 2005 to 2008. They had dialogues to share their thoughts on what elements of payment systems were missing. Then they set

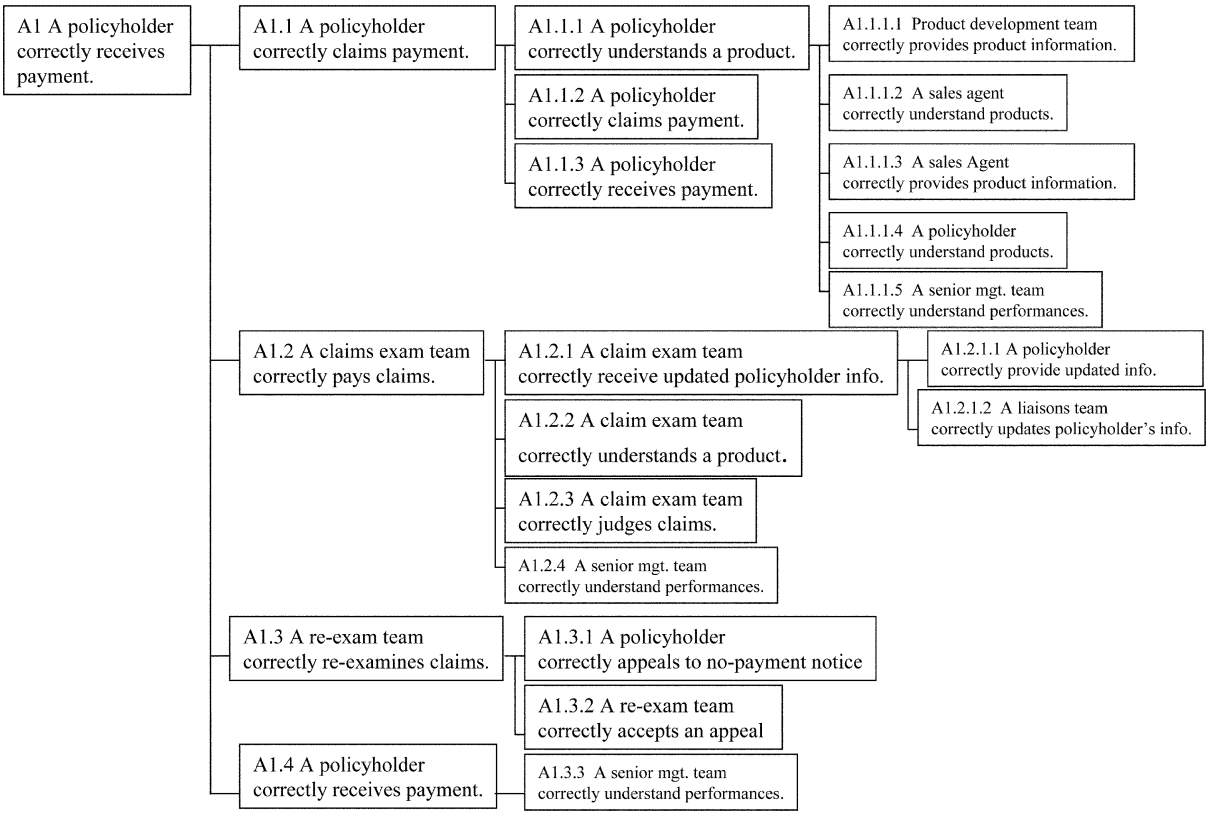

Figure 7. The activities-diagram of a claims-payment system. (Source: adapted from Shirasaka [2009: 6, Fig. 7]).

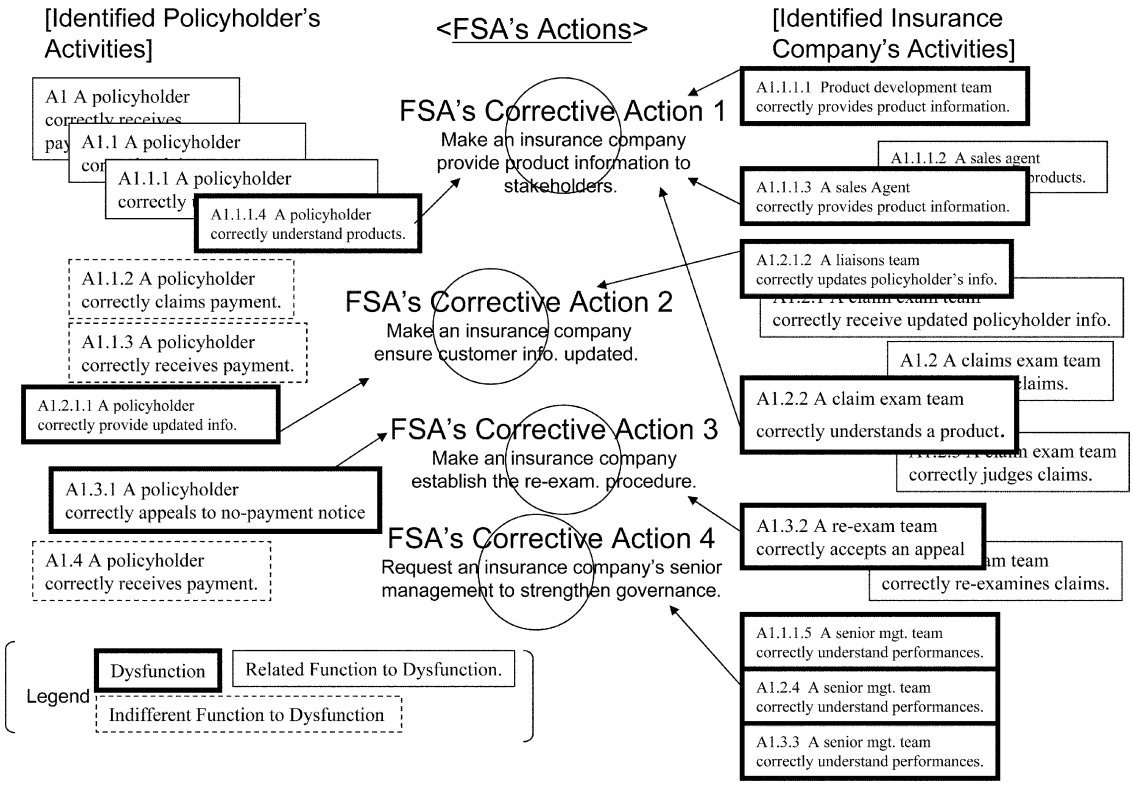

Figure 8. The development of activities-diagram for the FSA's corrective actions.

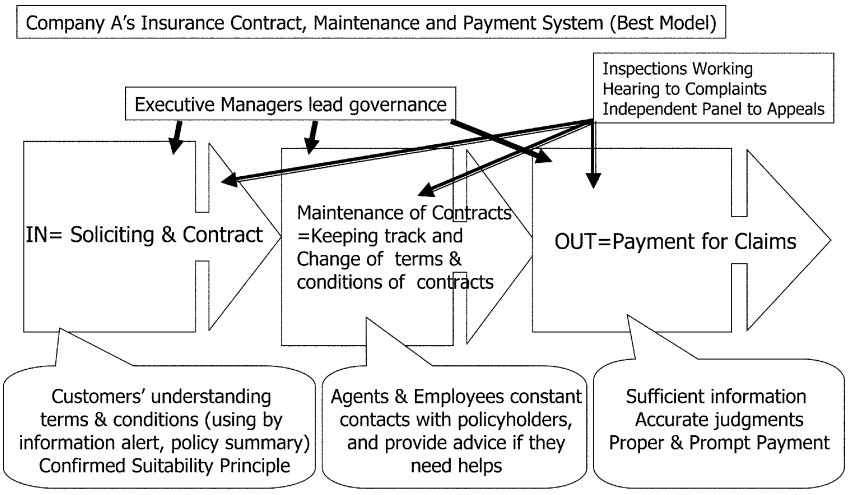

Figure 9. Insurance payment system (the TO-BE model): connected and envisioned from In to Out.

their goals. Their agreed view can be summarized as the AS-IS and the TO-BE models in Figures 9 and 10.

The AS-IS model and the TO-BE model are standard notions of enterprise architecture. The AS-IS model describes an actual state or condition of the system of interest. The TO-BE model describes the shared goals among stakeholders of the system. FSA and Japanese insurance firms actually did not use either of the AS-IS model and the TO-BE model to share understanding the state and condition of their failed systems and to set their common goal to achieve. However, it is perceived that FSA and insurance companies shared unwritten but very similar pictures of the AS-IS model and the TO-BE model of enterprise architecture when we read FSA's official notices on the no claim payments and payment leakages issue [e.g., FSA, 2005c, 2005d, 2007a, 2008c]. Thus in this subsection we use the AS-IS model and TO-BE model to describe shared images in reality and goal of FSA and companies on this issue.

The TO-BE model: All business flow is connected and envisions its quality from in to out. Proper governance of executives and inspections are functioning (see Fig. 9). In the soliciting and the contacting stage, a customer well understands the terms and conditions of the insurance policy. In the maintenance stage, agents and employees constantly contact customers to reflect changes in their needs and to provide advice if needed. In the payment stage, sufficient information is gathered to make accurate judgment to pay customers' claims properly and promptly.

The AS-IS model: This is what actually happened in Japan's private insurance companies. Lack of governance resulted in those systems being disconnected and remaining dysfunctional for those three stages (see Fig. 10).

This dialogue process corresponds to the "rich picture phase" of the SSM. By drawing the rich picture, and by writing a conceptual model, the SSM cultivates room to accommodate problem owners and stakeholders. Similarly, by sharing both models, the FSA and the insurance industry

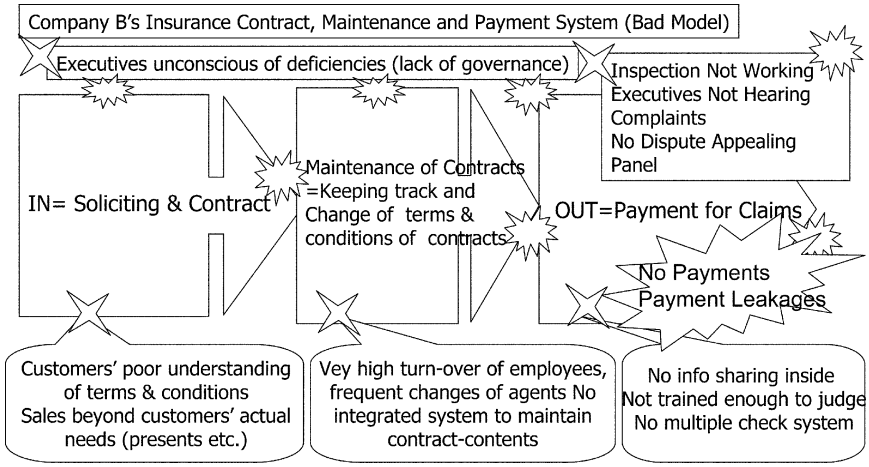

Figure 10. Insurance payment system (the AS-IS model): The FSA found it disconnected and disrupted.

stood for the first time on common ground. It was to recognize the insurance company's public role (externality), the importance of undisrupted payment upon a policyholder's request (mission criticality), and the significance for integrating technological and human aspects of the claims payment system to regain confidence from policyholders (reliability). The FSA and the insurance industry reached four corrective actions in Figure 8 for the system failures.

5.4. The FSA's New Systems Approach To Accommodate Objectives

Table II shows the chronology of the nonpayments cases from 2005 to 2008 summarizing FSA actions [2005a, 2005b, 2005c, 200d, 2005e, 2006b, 2006c, 2006d, 2006e, 2007a, 2007b, 2008b, 2008c]. This table shows that there is some common pattern in these cases:

- Some nonpayment or payment leakage cases emerged.
- The FSA issued reporting orders to insurance companies seeking feedback on all similar cases. This action consequently contributed to letting the FSA share the rough picture about the nonpayment cases in a way similar to drawing rich pictures of the SSM.
- The FSA held hearings and a scrutinized survey of reports submitted by the insurance companies.
- The FSA issued public announcements of the survey results.
- Administrative correction orders (business suspension orders and/or business improvement orders) were issued to make insurance companies improve their internal control, governance, and function of their claims-payment systems. This was the accommodation phase to push claims-payment system recovery.
- The insurance companies submitted their business improvement plans to the FSA. They voluntarily committed to their action plan to improve their deficiencies.

5.5. FSA Unintentionally Applied the Vee Model To Solve System Failures

The above pattern of actions taken by the FSA and the insurance industry exactly corresponded to the "soft" systems-approach. It applied the Vee Model to SCS on the six stages set out above. Nonetheless, there is no explicit evidence to show that the FSA consciously applied the Vee Model to solve these system failures. But the FSA used the "soft" systems approach with the insurance industry to share the goal of problem solving. Here we observed the six steps of the Vee Model which the FSA and the insurance industry followed (see Fig. 11).

5.5.1. Stage 1: Recognizing a Failure

They observed the FSA's initial inspection results of insurance companies, and media coverage of nonpayments or payment leakages were utilized. Failures emerging in the claims-payment system were thus recognized.

5.5.2. Stage 2: Identifying Where and What Kind of Failures

Mandatory reporting orders were issued. For insurance companies, it was the first major contact to the FSA for problem solving. Reports were so detailed; they contained all information regarding nonpayment cases regarding categories, figures, and possible causes. Cases of governance-failures, deficiencies of the double check systems, and even responsibility of the senior management team were also reported. The AS-IS model (Fig. 10) was the fruit of all information gathered in this process.

5.5.3. Stage 3: Grasping the Total System Structure and Analyzing the System Requirement

The FSA held intensive hearings with the insurance companies. They used the reports that insurance companies submitted before for goals sharing. Successive dialogues between the FSA and insurance companies were coordinated to ensure cooperative work to create a TO-BE model (Fig. 9).

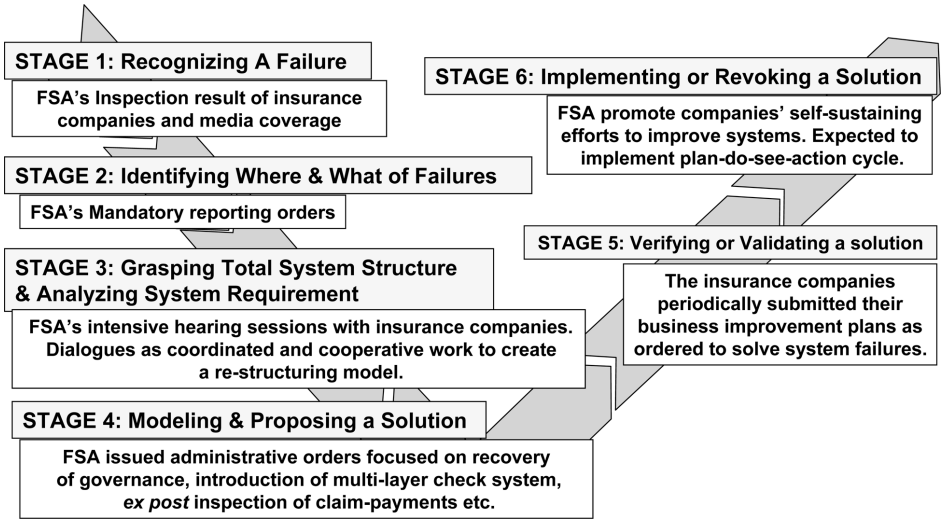

Figure 11. The FSA unintentionally applying the Vee Model: six stages.

5.5.4. Stage 4: Modeling and Proposing a Solution

The FSA issued administrative orders. These orders were intended not as a "verdict," but rather were issued to announce the shared goals with the insurance industry for fixing their failures of internal control. The content of the orders was focused on several specific measures: recovery of governance, introduction of a multilayer check system, creation of the *ex post facto* inspection team of claim payments, and intensive coordination of different sections in the same company. These measures were essential to once again satisfy the clients' requirements.

5.5.5. Stage 5: Validating a Solution

The insurance companies submitted their business improvement plans. These plans were periodically resubmitted to let the FSA monitor the speed and status of improvement.

The FSA implemented the "Public Opinion Poll on Financial Services Users' Satisfaction" in 2006 and in 2007 [FSA, 2006a, 2007c]. In comparing these two surveys, we noticed that financial services consumers who felt dissatisfaction with services offered by insurance companies drastically decreased from 34.8% in the 2006 poll to 21.6% in the 2007 poll. Although the satisfaction rate also somewhat decreased from 19.1% to 13.4%, the above numbers are the quantitative validation of effectiveness of the FSA's Vee Model approach.

5.5.6. Stage 6: Implementing or Revoking a Solution

The FSA's insurance policy reviews [FSA, 2007d and 2008a] encouraged insurance companies to promote self-sustaining efforts to improve their claim-payment systems. An insurance company is expected to implement for itself the "plan-do-see-action" cycle. This "plan-do-see-action" cycle is, in the FSA's intention, similar to the six stages in the SCS-applied Vee Model with architecture adjustment and iteration. FSA expects insurance firms to adjust their claim-payment system to achieve better payment performances by applying the Vee Model iteratively for themselves.

5.6. SCS, System Complexity and the Vee Model

A social system is complex because the system emergence cannot be easily explained by cause-effect relations. The unpredictability of emergence comes from uncertainty in elements interactions and self-organization in a system [Wilson, 2001: 334–335]. An SCS is the most complex system because its elements have human-centric functions and therefore highly unpredictable outcome of exogenous inputs to the SCS.

The Vee Model is the efficient system architecture to address to a system failure of interest, corresponding to emergence of system of interest, by adjusting six steps from dividing system elements to synthesis of the system and iterating the whole six processes. This flexibility of the Vee Model with iteration made the Vee Model best to address a failure of the social system which is characterized by its unpredictable emergence. An SCS, the system that is most characteristic of the social system, is relevant to systems engineering application of the Vee Model.

6. CONCLUSIONS AND FURTHER RESEARCH

6.1. Conclusions

A group of social systems is eligible to be the subject of a systems-approach. A social system has three elements, i.e., roles, norms, and values. Nonetheless, it is not sufficient for a social system to be the subject of systems engineering with these elements.

It is useful to apply the multiple viewpoint model of systems engineering to create a new approach. A social system on the human activity view is transformed to a socio-critical system in the Holon view.

A Socio-Critical System (SCS), a layered social system in the Holon view, has three elements; externality, mission criticality, and reliability. An SCS is usually a complex and large-scale system. So the Vee Model is applied when it fails and needs to be fixed.

The Vee Model is a "soft" approach to accommodate goals of a system designer, problem owners, and stakeholders to solve ill-defined problems.

The claims-payment system of insurance companies meets the criteria of an SCS. Thus we can apply the Vee Model for an SCS problem.

Massive nonpayment and payment leakage cases emerged in Japan's insurance companies in 2005–2008. By applying a systems approach, even unconsciously, the FSA intervened in business conduct of Japanese insurance companies in order to solve failures of their claims-payment systems. The FSA's intervention with a systems approach breaks new ground in providing the Government of Japan with a systems engineering rationale to take action for systems failures of the social system for public policy purposes. This systems engineering rationale may develop a new methodology for a government to achieve better regulations and enforcement of how it is involved in economic activities and contracts in the private sector, where we used to consider a government to be prevented from any involvement in private activity and private contracts even in the case of social system failure.

6.2. Further Research

There are two agenda items for further research:

First, the case study of the FSA's implicit usage of the Vee Model does not sufficiently prove its common effectiveness for all SCSs. Further research opportunities exist for explicit consideration of the Vee Model solving a problem in an SCS, and its qualified measurement.

Second, we identified that the socio-critical system had three elements (externality, mission critically, and reliability). However, it has not been proved that every social system which has these three elements is an SCS. This necessitates future study.

ACKNOWLEDGMENT

The author gratefully acknowledges the insightful and valuable comments received from four anonymous referees dur-

ing reviews of this manuscript for publication. The author also acknowledges advice and encouragement from colleagues of the Keio University Graduate School of System Design and Management. Nonetheless, all of views expressed in this manuscript are those of the author alone.

REFERENCES

K. E. Boulding, Beyond economics: Essays on society, religion and ethics, The University of Michigan Press, Ann Arbor, MI, 1968.

P. Checkland, Systems thinking, systems practice, Wiley, New York, 1981.

P. Checkland and J. Scholes, Soft systems methodology in action, Wiley, Chichester, West Sussex, UK, 1990.

W. N. Dunn, Public policy analysis: An introduction, 4th edition, Pearson Education, Upper Saddle River, NJ, 2007.

D. Easton, A systems analysis of political life, Wiley, New York, 1965.

FSA (Financial Services Agency), Administrative action against Meiji-Yasuda Life (in Japanese), http://www.fsa.go.jp/news/newsj/16/hoken/f-20050225-1.html, Government of Japan, Tokyo, February 25, 2005a.

FSA (Financial Services Agency), Administrative actions against Meiji-Yasuda Life and other companies (in Japanese), http://www.fsa.go.jp/news/newsj/17/hoken/f-20051028-3.html, Government of Japan, Tokyo, October 28, 2005b.

FSA (Financial Services Agency), Result in review of payment control systems and no claim-payment cases of Japan's life insurance companies (in Japanese), http://www.fsa.go.jp/news/newsj/17/hoken/f-20051028-4.html, Government of Japan, Tokyo, October 28, 2005c.

FSA (Financial Services Agency), Result of research on payment-leakages in collateral benefits of automotive insurance of Japan's general insurance companies (in Japanese), http://www.fsa.go.jp/news/newsj/17/hoken/f-20051125-7.html, Government of Japan, Tokyo, November 25, 2005d.

FSA (Financial Services Agency), Administrative actions against 26 general insurance companies of Japan (in Japanese), http://www.fsa.go.jp/news/newsj/17/hoken/f-20051125-5.html, Government of Japan, Tokyo, November 25, 2005e.

FSA (Financial Services Agency), 2006 public opinion poll on financial services users' satisfaction (in Japanese), http://www.fsa.go.jp/news/newsj/17/20060407-3.html, Government of Japan, Tokyo, April 7, 2006a.

FSA (Financial Services Agency), Administrative action against Sompo Japan (in Japanese), http://www.fsa.go.jp/news/newsj/17/hoken/20060525-1.html, Government of Japan, Tokyo, May 25, 2006b.

FSA (Financial Services Agency), Administrative action against Mitsui-Sumitomo Fire & Marine (in Japanese), http://www.fsa.go.jp/news/newsj/17/hoken/20060621-1.html, Government of Japan, Tokyo, June 21, 2006c.

FSA (Financial Services Agency), Administrative action against Nippon Life (in Japanese), http://www.fsa.go.jp/news/18/hoken/20060726-2.html, Government of Japan, Tokyo, July 26, 2006d.

FSA (Financial Services Agency), Completion period of general insurance companies' surveys about payment-leakages in collateral benefits of automotive insurance (in Japanese), http://www.fsa.go.jp/news/18/hoken/20061117-3.html, Government of Japan, Tokyo, November 17, 2006e.

FSA (Financial Services Agency), Result of research on no claim-payment cases in the third sector products of Japan's general insurance companies (in Japanese), http://www.fsa.go.jp/news/18/hoken/20070314-1.html, Government of Japan, Tokyo, March 14, 2007a.

FSA (Financial Services Agency), Administrative actions against 10 general insurance companies of Japan (in Japanese), http://www.fsa.go.jp/news/18/hoken/20070314-2.htm, Government of Japan, Tokyo, March 14, 2007b.

FSA (Financial Services Agency), 2007 public opinion poll on financial services users' satisfaction (in Japanese), http://www.fsa.go.jp/news/18/sonota/20070322-1.html, Government of Japan, Tokyo, March 22, 2007c.

FSA (Financial Services Agency), FSA's Administrative Supervision Policy for Insurance Companies 2007 (in Japanese), http://www.fsa.go.jp/news/19/hoken/20071119-1.html, Government of Japan, Tokyo, November 19, 2007d.

FSA (Financial Services Agency), FSA's Principles for Financial Services Industry of Japan (in Japanese), http://www.fsa.go.jp/news/19/20080418-2.html, Government of Japan, Tokyo, April 18, 2008a.

FSA (Financial Services Agency), Administrative actions against 10 life insurance companies of Japan (in Japanese), http://www.fsa.go.jp/news/20/hoken/20080703-6.html, Government of Japan, Tokyo, July 3, 2008b.

FSA (Financial Services Agency), Result of fact-finding survey on payment status of Japan's life insurance companies (in Japanese), http://www.fsa.go.jp/news/20/hoken/20080703-5.html, Government of Japan, Tokyo, July 3, 2008c.

K. Forsberg, H. Mooz, and H. Cotterman, Visualizing project management, 3rd edition, Wiley, Hoboken, NJ, 2005

S. Jackson, Architecting resilient systems: Accident avoidance and survival and recovery from disruptions, Wiley, Hoboken, NJ, 2010.

S. Jackson, D. Hitchins, and H. Eisner, What is the systems approach? INCOSE INSIGHT 13(1) (April 2010), 41–43.

N. Luhmann, Soziale Systeme: Grundriß einer allgemeinen Theorie, Suhrkamp Verlag, Frankfurt am Main, 1984.

J. Nadler, "Systems methodology and design," System design for human interaction, A. P. Sage (Editor), IEEE Press, New York, 1987, 265–277.

T. Parsons, The social system, Free Press, New York, 1951.

T. Parsons, The structure of social action, Free Press, New York, 1967, Vols. 1 and 2.

A. R. Poteete, M. A. Janssen, and E. Ostrom, Working together: Collective action, the commons, and multiple methods in practice, Princeton University Press, Princeton, NJ, 2010.

W. B. Rouse, Model of human problem solving: Detection, diagnosis, and compensation for systems failures," System design for human interaction, A. P. Sage (Editor), IEEE Press, New York, 1987, 278–290.

A. P. Sage and J. E. Armstrong Jr., Introduction to systems engineering, Wiley-Interscience, New York, 2000.

A. P. Sage and W. B. Rouge (Editors), Handbook of systems engineering and management, 2nd edition, Wiley, Hoboken, NJ, 2009.

S. Shirasaka, A standard approach to find out multiple viewpoints to describe an architecture of social systems: Designing better payment architecture to solve claim-payment failure of Japan's

insurance companies, INCOSE 2009 Singapore Symp Proc, USB Memory, July 20–23, 2009, 3.3.3.
J. Wilson, "Scientific uncertainty, complex systems, and the design of common-pool institutions," The drama of the commons, Committee on the Human Dimensions of Global Changes, E. Ostrom, et al. (Editors), National Academy Press, Washington, DC, 2001.

Toshiyuki Yasui is a Special Research Professor, Keio University Graduate School of the Systems Design and Management. Prior to the current position, he served as Councilor of the Financial Services Agency (2008–2009). Upon graduating from the University of Tokyo with a BA in International Relations in 1985, he joined the Japanese Ministry of Finance and spent 25 years in various government posts. His interests include systems approach to public policy, social systems theory, and systems of finances and currencies. Toshiyuki belongs to 12 professional societies including the American Society for Public Administration and the Japan Association for Social and Economic Systems Studies. He recently received the 2010 Best Thesis Award from the Japan Society of Competitive Intelligence. Toshiyuki also serves for National Graduate Institute for Policy Studies of Japan as Visiting Professor.