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Fostering *Fukushima*'s Future: Grass-Rooted Policy Design in Post-Disaster Japan by Participatory Systems Analysis

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Abstract. *Recent developments of the service science and the social design broke the new academic grounds for new methodologies of the policy design. On the service science side, the concept of co-creation is proposed. On the social design side, there have emerged methodologies of the participatory systems analysis. Based upon these developments, this paper is to propose the Participatory Systems-Design of Policy (PSP), a new methodology of the participatory system analysis by using the Bayesian network modeling for the grass-rooted policy design. The authors chose the Fukushima, one of most troubled area caused in north-east Japan by the Great Earthquake in March 2011, as a research field to verify and validate in quantitative manner the effectiveness of this methodology. The results showed this methodology fostered both the creativity and the sense of collaborative ownership of policy design, which are core values to realize better governance of a community.*

Keywords. *Co-Creation, Participatory Systems Analysis, Policy Design.*

1 Introduction

The service science is heading for the era of appreciating the value co-creation (Prahalad and Rawaswamy, 2000) (Rawaswamy and Goulliart, 2010). The value co-creation theory makes much of collaborative process to produce values long before a consumer purchases a service from a company (Xie *et al*., 2008). For a consumer, invisible and intangible service is dominantly important (Vargo and Lusch, 2004). A consumer, the conventional service-receiver, now seeks for an active engagement in creating values with the industry (Grönroos, 2006). The industry also pays keen attentions to the value co-creation service model since companies adopting the co-creation model are more competitive than other companies in the manufacturing and services market (Ueda *et al*., (2008)).

The discipline of social design echoes with the recent trend in the service science. The participatory systems analysis (hereinafter called 'PSA'), a new methodology for adaptive management, is proposed to involve and accommodate (Checkland and Scholes, 1990) all stakeholders related to a problem of a social system and to co-design (Sanders and Stappers, 2008) a solution to the problem. The term 'participatory' refers to stakeholders' participation as a bottom-up approach. And the term 'systems analysis' refers to identifying the root causes of a problem and systemically finding a solution for the society (Smith *et al*., 2007). The collective intelligence emerged from human groups who participate in the collective works performs significantly better than individual intelligence (William Woolley *et al*., 2010).

By contrast, the public service, a service provided by a government that serves for taxpayers with designing public policies for them, is deemed the most backward to absorb the above two developments in disciplines of service and social design. A government service has been a synonym for ponderous, inflexible and obsolete service for years among industrialized countries (Kamarck, 2007) (Raadschelders *et al*., 2007). Among those countries, Japan faces the severe challenge. According to the recent survey done by the Accenture (Kuroda, 2009), the Japanese is satisfied least but two among surveyed 21 countries with administrative services that they receive. They are particularly dissatisfied in the evaluation items of 'listening to and matching the taxpayers-needs', 'public-private collaborations for needs', and 'accountability and trust'. To make matters worse, trust for the public services in Japan was significantly lost after the 3-11 Eastern Japan Great Earthquake and subsequent the nuclear accident of the *Fukushima Daiichi* Nuclear Power Station (Nomura Research Institute, 2011).

The public service needs a new methodology which is equipped with both participatory and collaborative system analysis to enable stakeholders co-designing a public policy for them. This methodology will recover the trust from taxpayers since it satisfies the most appreciated values of them. It may be particularly effective in the country like Japan, where the stakeholders thirst for co-creating experiences in the post-disaster reconstruction phase.

Thus this paper is to propose the Participatory Systems-Design of Policy as the new systems approach to improve the public service by introducing the participatory and co-design methodology to policy creating process. The proposed approach will be put for validation in the stressed field of post-disaster Japan.

2 Participatory Systems-Design of Policy: Methodology

The Participatory Systems-Design of Policy (hereinafter called 'PSP') is defined as a hybrid system-analysis which is endorsed by both theories of the value co-creation and the PSA. The authors propose the PSP for the policy-creating process in order to overcome low satisfaction with the conventional public-service providers. The term 'participatory' of PSP refers to stakeholders' participation to identify collaboratively rooted causes of the problem of the social system with which they are concerned. And the term 'systems design' refers to systems engineering approach for finding a

design solution to create an innovative public policy for the failed social system. It also provides stakeholders a husbandry experience of their community (Gratz, 1989). PSP apply several holistic-thinking tools to the targeted problem as the integral part of the architecture; brainstorming and KJ Method (Project Management Institute, 2008); system dynamics and causal loops diagram (Legasto *et al*., 1980); prototyping for empathy (Stanford University d.School, 2012); and Bayesian belief network (Ames and Neilson, 2001).

The previous studies on the PSA mainly focused the conversational leadership in an organization (e.g., Brown and Isaacs, 2005), innovation and its catalyst for an organization (e.g., Dvir *et al*., 2006), and adaptive management of an organization (Smith *et al*., 2007). Based upon these rich researches, this paper is to break the new ground for applying the PSA, a new collaborative design approach, to the process of policy creation. In addition to it, the paper also explores the possibility of the PSA to be a systems-engineering methodology for a socio-critical system (Yasui, 2011).

PSP has five sequential steps to create collaboratively a public policy by stakeholders' hands; a) formulating the problems structure, b) drawing the causal loop diagram, c) deciding systemic interventions points, d) developing the Bayesian network modeling, and e) deciding the leverage point for policy intervention. Five steps and corresponding tools to each step are listed in Table 1.

Table 1. Five steps of SPS and corresponding tools to each step.

Step #	Contents of Step	Tools (Examples)
#1	Formulating the problems structure	Brainstorming, KJ Method
#2	Drawing the causal loop diagram	System Dynamics
#3	Deciding systemic interventions points	Systems Dynamics, Prototyping for Empathy
#4	Developing the Bayesian belief network	Bayesian belief network
#5	Deciding the leverage point for policy intervention	Inductive sensitivity analysis

3 Empirical Validation: PSP Workshop for Jobs in *Fukushima*

This section is to validate empirically the efficacy of PSA as the methodology to create systemically and successfully a public policy with stakeholders' hands.

As for a field for the validation, a workshop was held in the *Fukushima* University on December 11th, 2011 with 15 members representing local communities and local governments. Thus the workshop naturally entailed characteristics of the consensus conference (Grundahl, 1995) since the policy experts and the ordinary citizens both jointed in one panel for searching a better policy idea.

Fukushima is one of the most devastating areas hit by a chain of mega disasters from the big earthquake, to the unprecedented *tsunami,* and to the nuclear accident. This devastating area now faces quite a tough challenge to lose rapidly its industries and population because the radio-active issue shadows wishes of *Fukushima* residents to

hit the road for post-disaster re-construction. This urgent concern made participants to the workshop on that day chose 'Jobs in *Fukushima*', on how they will able to stand a policy to attract employments again to *Fukushima* in the near future.

The workshop went along with five steps which PSP stipulated. Participants were divided into three tables with five members. All three tables successfully proposed collaborated policy idea for employment with concrete narratives and images respectively.

3.1 Formulating the problems structure

Three tables implemented brainstorming sessions and raised more than one hundred factors which may influence the employment in *Fukushima*. Those ideas were grouped to several policy agenda by participants according to the KJ Method (Figure 1). This step as formulating the problems structure was completed in 45 minutes in that workshop.

Fig. 1. Brainstorming and the KJ Method Session of 'Jobs for Fukushima' workshop (December 11th, 2011 at the *Fukushima* University, Photos by Yasui, T.)

3.2 Drawing the causal loop diagram

Three tables competed with each other for drawing the causal loop diagrams. This step facilitated participants to visualize and share the holistic picture of the problems in which factors were perplexedly connected and looped. Three tables identified six loops in total.

3.3 Deciding systemic interventions points

Based upon the causal loop diagrams drawn in the previous subsection, the participants identified the systemic interventions points, which are equivalent to leverage points (Senge, 1990) in order to prevent loops from reinforcing adverse effects. Three tables decided four systemic interventions points in total; keeping on 3-11 memories alive, cleaning the radioactive fallouts from soils of *Fukushima*, making the learning tourism center about the energy policy, and getting local residents more united with the forests (Figure 2).

The participants then developed their policy outcome images on four identified interventions points according to the method of prototyping for empathy (Figure 3). Those prototypes visualized directions for which the Japanese government will have to head as the employment policy for *Fukushima*; a) recovering the employments in agriculture by adhering to the more strict their own standard about residual radioactive to agricultural products shipped from *Fukushima;* b) boosting the employments in the tourism industry to launch a learning tour project about nuclear and renewable energy; c) attracting the educational industry and gathering attentions of families by enhancing the symbiotic primary education with the forests (Figure 4).

Fig. 2. Causal Relation Diagram and Systemic Interventions Points identified by one table (December 11th, 2011 at the *Fukushima* University, Photos by Yasui, T.)

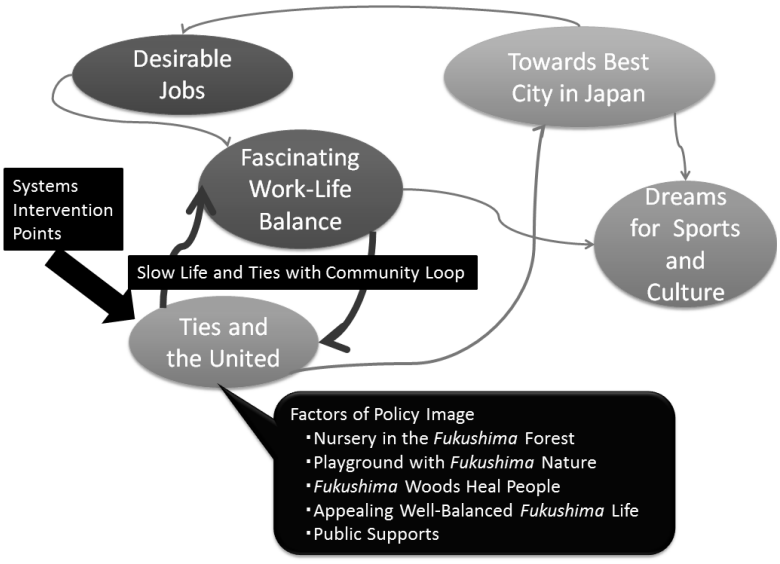

Fig. 3. From Causal Relation Diagram to Policy Factors (December 11th, 2011 at the *Fukushima* University)

Fig. 4. Prototype for Empathy Made by one of three tables (December 11th, 2011 at the *Fukushima* University, Photos by Yasui, T.)

3.4 Developing the Bayesian belief network

The policy experts' panel held on February 27, 2011 at the Keio University Hiyoshi Campus developed the Bayesian belief network of policy outcome images proposed in the previous subsection. Three experts judged which policy alternatives corresponds to policy outcomes. They identified eight policy alternatives and three intermediary parameters with three above-mentioned policy outcome images leading to the ultimate policy goal; fostering jobs in Fukushima. The policy experts also quantitatively decided by their expert judgments how much conditional probability each alternative or outcome has. Figure 5 is the Bayesian belief network structured by the panel. According to their modeling, the probability that *Fukushima* will be able to foster their jobs, if the current probabilities of policy alternatives continue, is only 55% (Figure 6).

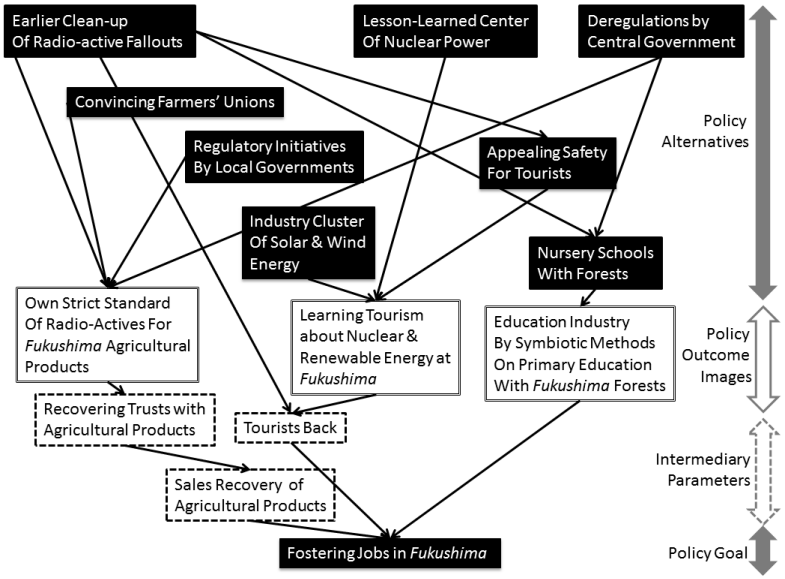

Fig. 5. Structure of the Bayesian belief network 'Fostering jobs in *Fukushima*'

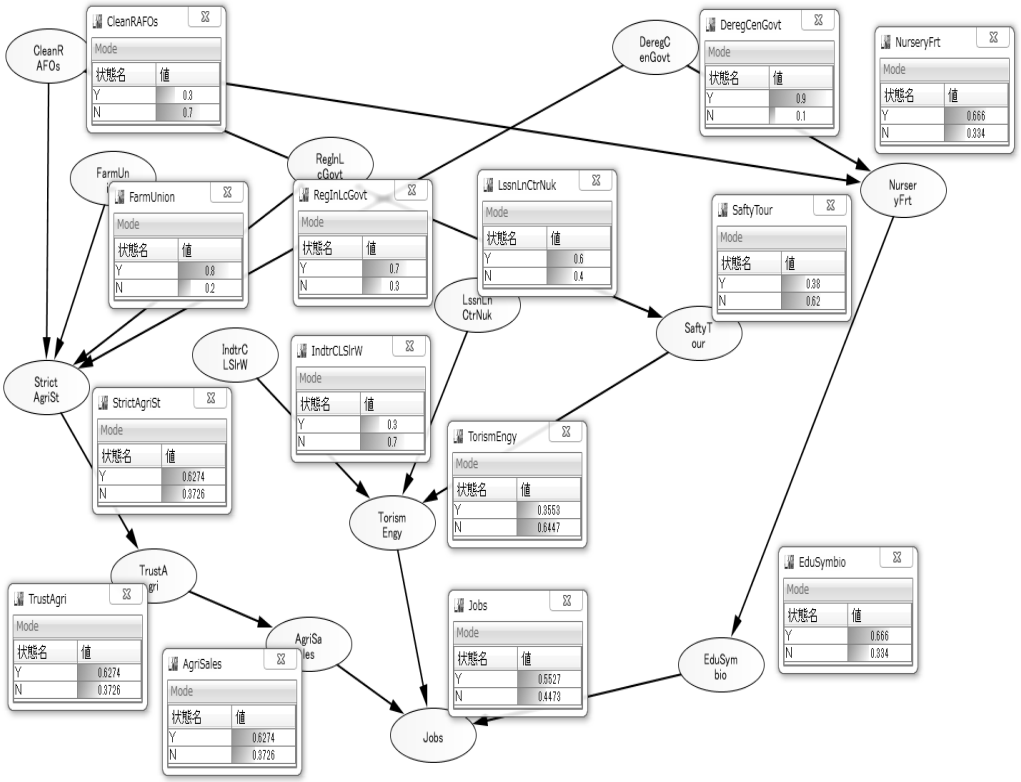

Fig. 6. Bayesian belief network of 'fostering jobs in *Fukushima*: Estimates in default

3.5 Deciding the leverage point for policy intervention

The experts carried out the sensitivity analysis of policy alternatives for the developed Bayesian belief network in the previous subsection. The sensitivity analysis was implemented for this case to evaluate how much effect to the targeted policy goal each alternative has if such an alternative is done with 100% sureness (Table 2).

The Table 2 shows two policy alternatives the significantly effective to achieve the policy goal; earlier clean-up of radio-active fallouts (26% point) and appealing the safety for potential tourists to Fukushima (21% point). Therefore, these two policy alternatives are decided as the leverage points for the policy goal of this case.

Table2. Sensitivity analysis of the policy alternatives in the Bayesian belief network of 'Jobs in *Fukushima*'.

Policy Alternatives	Probability of the Goal in Default (%)(a)	Probability of the Goal if this alternative is done 100% (%)(b)	Sensitivity (% point) (c=b-a)
Earlier clean-up of radio-active fallouts	55	81	26
Appealing the safety for potential tourists to Fukushima		76	21
Starting the Nursery schools with the *Fukushima* forests		71	16
Regulatory initiatives by local governments		59	4
Constructing the Lesson-Learned Center of the nuclear accident		59	4
Convincing farmers' unions		58	3
Establishing the industry cluster of solar and wind energy		58	3
Deregulations by the central government		58	3

4. CONCLUSIONS

The PSP, a proposed systems-approach for social-design method was proved to be effective for creating a bottom-up-based public policy with collective intelligence of stakeholders of the community. The case of Fukushima workshop validated that the PSP worked for achieving accommodation among participants and thus guiding them to the process of co-creating employment policies for their community.

5. FURTHER RESEARCH AGENDA

The authors recognized two further research agenda for the PSP. One is to extend the scope of efficacy to other services than public services. Certainly there will be many services industries which may be benefitted from the participatory and collaborative social-design methodology. Another is to identify thresholds which enable emergent properties of the social system appear with catalyzing effects of the PSP platform. Possibly the '*Ba*' (Nonaka and Konno, 1998), the conceptual platform for collaborative design in social sense may have critical role to catalyze such emergence.

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