

A Scientific Challenge for Society under Sustainability Risks by Addressing Coping Capacity, Collective Knowledge and Action to Change: A Vitae System Perspective

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ABSTRACT

This paper points to the need for undertaking field-based, innovative, intellectual ventures to explore a yet-missing scientific domain of “Implementation Science”. A Vitae System Perspective is proposed to show that seemingly different research arenas are interpreted to share common concerns, hotspots and fundamental issues such as how to manage and realize “more sustainable” society (that is, sustainable management), how to develop a better methodological leverage toward it and what kind of new scientific framework should be further explored. Illustrations are made to link together three seemingly different research frontiers. i.e., IDReM (Integrated Disaster Risk Management), CRREM (Conflict Resolution in Resources and Environment Management), and Kasology (sustainable rural development). Some ongoing scientific challenges by the author and others are introduced and discussed. By referring to interpretively relevant ideas, thoughts and research works, further allied endeavors to enhance “Implementation Science” for sustainable society are called for.

Keyword: Coping Capacity, Collective Knowledge and Action to Change, Vitae System, Sustainability Risk Management, Implementation Science

1. Introduction

Recognizing that we live in the century of ever-increasing complexity, uncertainty and risks associated with sustainability, this paper points to the need for undertaking field-based, innovative, intellectual ventures to explore a yet-missing scientific domain of “Implementation Science”. A Vitae System Perspective is proposed based on author’s long-engaged scientific ventures flagged by the three seemingly different research frontiers. i.e., IDReM (Integrated Disaster Risk Management), CRREM (Conflict Resolution in Resources and Environment Management),

and Kasology (sustainable rural development). From this perspective, the author points out that the above three different research frontier arenas are interpreted to share common concerns, hotspots and fundamental issues such as how to manage and realize “more sustainable” society (that is, sustainable management), how to develop a better methodological leverage toward it and what kind of new scientific framework should be further explored.

To illustrate the above points, a focus is placed on the necessity and practice of addressing coping capacity and collective (multi-lateral) knowledge and action to change. A point is made that the most

effective and viable way to scientifically address coping capacity is to focus on its changing processes, to monitor and keep track of such changes, and to qualitatively compare relative differences from one point in time to another.

Some ongoing scientific challenges by the author and others are introduced and discussed. By referring to interpretively relevant ideas, thoughts and research works, further allied endeavors to enhance “Implementation Science” for sustainable society are called for.

2. Sustainability Risks related to Vitae Systems

Knowing that the definitions of “sustainability” abound, the author intends to relate them to comprehensive risks to which “our common living spaces resided by human (and non-human) agents” such as regions, cities, villages, and neighborhood communities are increasingly exposed. Given any living space, the following three cardinal functions are essential to its sustainability (see Okada, 2006).

- 1) survivability (to become alive)
- 2) vitality (to live lively)
- 3) communication (to live together)

Fig. 1 illustrates the three functions modeled as three edges of a vitae system triangle which represents the common space at stake, in light of sustainability. Fig. 2 shows a networking of vitae system triangles with “communication vertex” as common hinges.

This entire living common space has two seemingly contradictory but mutually complementing functional orientations, one, self-sustainability and another, inter-sustainability, represented by the horizontal and vertical axes, respectively. As a matter of fact, the two sustainability orientations can hardly stand on their own and therefore, are thought of as the two sides of the same coin. In other words any common space conceived as a living body cannot achieve sustainability only by itself; instead one is very much interdependent on another staying outside. Beside the above “communication with outside”, “communication within” the vitae system is also essential for three cardinal functions to become adequately coordinated.

Note that this conceptual model as it is has no specific implications regarding particular area-related or managerial characteristics or contents of the region (or city, village, or community) in question. Thus this model is totally context-dependent if it is intended to be applied (and operationalized) to a particular case. This means that in most cases the actual use of the Vitae System Model will require field work-based experience and skills as well cross-disciplinary knowledge on the part of researchers who intend to apply it. Therefore its perspective takes us to a challenge towards a new academic arena which spans and merges together different conventional disciplinary spheres. Interpretatively such a challenge per se is also a creative endeavor to connect together such disciplinary spheres regarded as distinct Vitae Systems. As long as we confine ourselves in our own traditional scholarly community, we cannot take an overview of our community from above and outside and thus fail to take even an initial step to relate ourselves with other communities. The Vitae System Model offers us a refreshing way of viewing things in order to guide us to take such an initial step forward.

Though the concept of sustainability is holistic and comprehensive, it is useful to limit its focus on

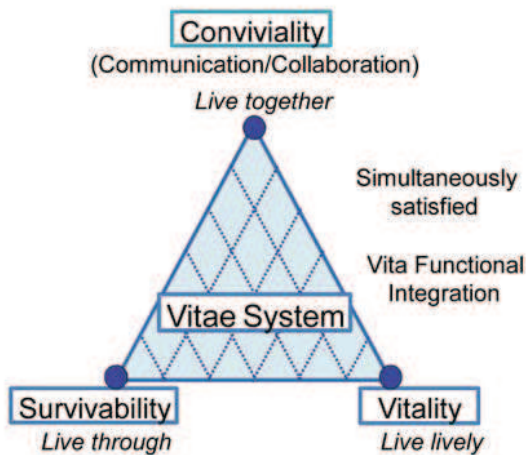


Fig. 1 Vitae System Model (Prototype)

Networking of Vitae Systems

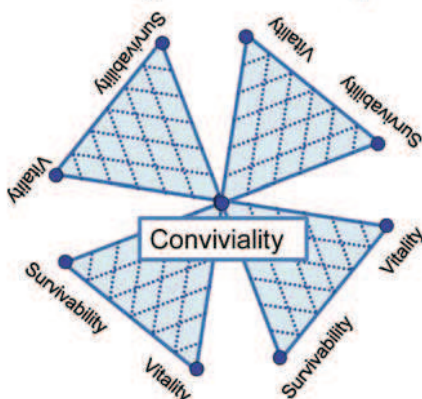


Fig. 2 Networking of Vitae Systems

its particular aspects, for the purpose of planning and management (that is called “sustainable management”) (for example, see Lovins, 2003). The UN Food and Agriculture Organisation (FAO) Types of Sustainability and some others have listed the following kinds of sustainability with their particular considerations for technical cooperation (Wikipedia, Sustainability).

- a) Institutional sustainability
- b) Economic and financial sustainability
- c) Ecological sustainability

In application, the above types of sustainability can be generalized to wider scopes of considerations. We may also add the following:

- d) Social sustainability (including that of our common living spaces, such as Kasology central issues)
- e) Energetic sustainability
- f) Natural hazard sustainability (directly addressing IDRiM central issues)

3. Coping Capacity and Its Enhancement

One of the essential, and most challenging questions of what we may call “Implementation Science” for sustainability risk management in the research arenas of IDRiM, CRREM and Kasology is coping capacity and its enhancement under sustainability risks. Conceptually the level (state) of coping capacity is modeled as the area of a vitae system triangle which represents a particular agent (stakeholder) engaged in sustainability risk management. In anticipation of objectively identified or perceived sustainability risks, proactive countermeasures need to be introduced well in advance so that any devastating damage and losses may be timely and properly avoided or reduced. In parallel to hardware (facility) development as infrastructure and entitlement, more software types of countermeasures (enhancing coping capacity) have to be specified, chosen and implemented. It is remarked that operationalization of the concept of coping capacity is not an easy task to do. Challenging scientific issues include:

- a) How to distinguish between ex-ante (expected) and ex-post (revealed) states of coping capacity
- b) How to develop its “metric“
- c) How to monitor and make measurements
- d) How to examine and assess the process of changing (transforming) the state of ex-ante coping capacity

(called “coping capability”).

In author’s view the most effective and viable way to scientifically address coping capacity is to focus on its changing processes, to monitor and keep track of such changes, and to qualitatively compare relative differences from one point in time to another.

To take an example of integrated disaster risk management (IDRiM) such a critical change in society may occur after a huge scale of disaster strikes a region. The 1995 Hanshin-Awaji Earthquake Disaster was precisely such a case. The 2001 September 11th New York Terrorist Attack is also considered another case. The former belongs to a natural hazard-triggered disaster, and the latter a malicious intent hazard which caused an unprecedented type of urban calamity. The structural changes may take place, and continue to do so in different periods of time from rescue, relief, recovery and restoration. The author claims that the Vitae System Model will shed light on such structural changes occurring particularly in the period of rescue and relief by modeling the dynamic process of change as an integration of achieving “survivability” above all, and then “vitality” and “communication” to follow in a coordinated manner. If we intend to address a longer period of time from rescue and relief, through recovery to restoration, it is advised to study the whole process by applying the methods of adaptive management which is modeled as the dynamic processes of spirally upgrading Plan-Do-Check-Action (PDCA) Cycles (see Figs. 3 and 4 to be explained later). One way to apply the Vitae System Model is to use it as a set of basic performance criteria to “check” if it remains to be viable for each cycle, in terms of “survivability” above all, and then “vitality” and “communication” to be well coordinated.

4. Collective (Multi-lateral) Knowledge and Action to Change

The primary research concern of implementation for sustainability risk management is how to formulate the process of risk knowledge leading to action to dispose risks. Interestingly the outcomes of such a knowledge-action process formulation work are also considered process knowledge and technology, and thus become a typical example of research focus for Implementation Science. Another important characteristics of implementation-oriented knowledge

to action is that it is NOT developed, or owned by individuals but collectively (a collection of individuals) or multi-laterally. In this relation adaptive management is considered to be effective as a methodology of sustainability risk management. Fig. 3 shows a prototype model of Plan-Do-Check-Action (PDCA) cycle process which is considered to have close relationship with adaptive management which requires to hypothesize “a policy or practice as a viable plan”. The essential difference between “Do” and ‘Action’ is that

“Do” addresses what stakeholders do according to the “Plan” that has been made in the preceding stage, and “Action” refers to what they make

retroactive adjustments according to what they have achieved “Check” about the performances and viability of the “Plan” that has gone through “Do”. “Action” thus brings in new inputs into plan, and involves new stakeholders into the participatory platform. One cycle of “Plan”, “Do”, “Check” and “Action” completes, the same process repeats itself until all stakeholders agree to terminate there.

5. Ecological Sustainability Risk Management as Recovering Community’s Coping Capacity with Natural Environment

The concept of Vitae System sheds light on the notion of “carrying capacity” of the natural environment and offers us another spectrum of its interpretation. “Mighty Nature” is only too vast and beyond any scope and can last even when human nature perishes. Therefore when the global communities are concerned about any limit to the capacity of the natural environment, the logical way to define that aspect of the nature is in terms of people’s capacity to relate themselves with it. The carrying capacity should be reinterpreted not only as the one that belongs to the natural environment itself but in part to any agent interacting with the natural environment. In that sense the carrying capacity is not that of the environment itself but relative to, and “communicative” with all agents concerned. From the viewpoint of community’s management the relevant carrying capacity

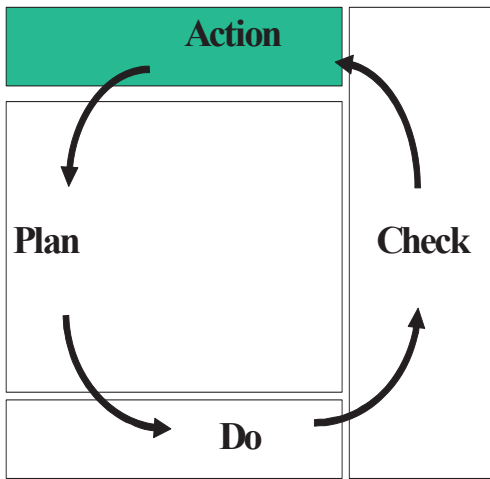


Fig. 3 Adaptive Management as Open-ended PDCA Cyclic Process

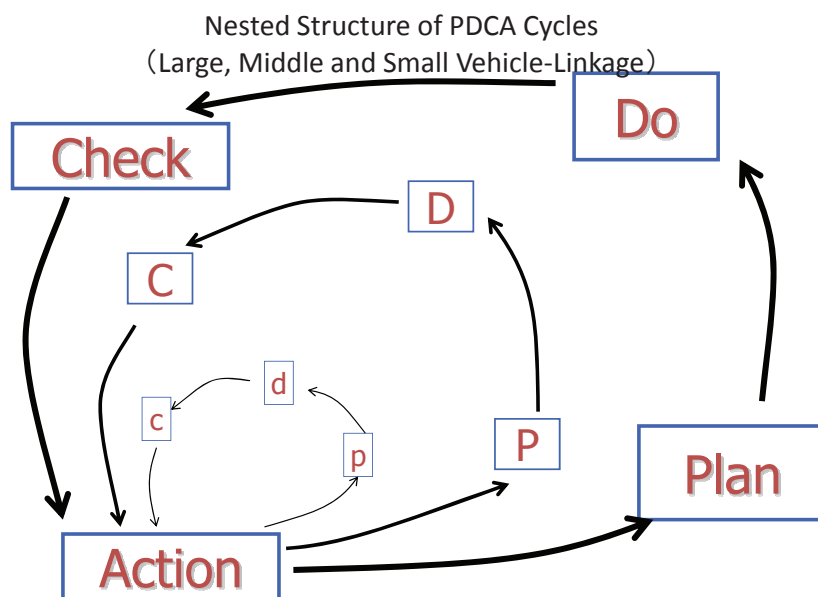


Fig. 4 Upgrading Spirally the Processes of Adaptive as Nested PDCA Cycles

should be defined and studied as people’s (community’s) coping capacity with its natural environment, which needs to be regarded as their perceived partner agent (another vitae system).

6. Three Frontier Research Arenas Placed in Vitae System Perspective

An attempt is now made to take up the above stated three distinct research frontier arenas and to reduce them to a common body of missing knowledge of what one may call “the meta-problem structure of sustainability risk management”. That is, the Vitae System Model provides an effective pointer to this logical reduction process. Table 1 illustrates how to specify survivability (S), vitality (V) and communication (C) to different possible patterns of content specifics-to-risk correspondence in each research arena (see **Table 1**). Note that there are many other alternative ways of specifications for each arena and that more exact and realistic details should be specified if a particular context (socio-cultural, locality, etc.) is set up. Some remarks are made to discuss peculiarities of each research arena.

1) IDRiM as Sustainability Risk Management

Table 1 (a) exemplifies just a few (potentially many) types of integrated disaster risk management

problems which can be patterned as combinations of specific contents corresponding to S-V-C risks. An important implication for any type of the problems is that disaster reduction management is not simply a matter of dealing with survivability risks (S) such as risk of loss of life or assets, etc, but it is more holistic and thus need to be integrated (coordinated) in terms of vitality risks (V) and communication risks (C).

It is worthy stressing that as indicated in Case IDRiM (4), each type of risk is not always simple but rather relatively complex and of a multi-stratum, such as a set of retrofitting failure-safe, illness recovery, economic survival (due to poverty), etc. This tells us that it is quite likely that a particular person who could be, say, very old and difficult to loan money from a bank gives a priority to overcoming illness and surviving economic hardship, rather than to implementing retrofitting. Such being the case, retrofitting would quite possibly be NOT IMPLEMENTED, which is precisely an example of implementation problem. A knowledge to be developed to get around this difficulty is, for instance, how to make people’s priority slightly reset (not just by forcing them to adopt that alternative.) Yet uncovered body of knowledge we may need includes people’s risk perception, attitudinal and behavioral characteristics. This is a perfect example of a theme to be addressed by “Implementation Science”.

Table 1 Specification of Sustainability Risks for IDRiM, Kasology, and CRREM

(a) IDRiM

Sustainability risk	IDRiM(1)	IDRiM(2)	IDRiM(3)	IDRiM(4)
S	Disaster reduction	rescue/relief	evacuation	1) retrofitting 2) illness 3) economic survival
V	development	recovery/ restoration	health/ handicap	financial resources
C	partnership	mutual assistance	early warning/ information	government assistance

In the above IDRiM (1) refers to the first conference of IIASA-DPRI International Conference (Forum) on Integrated Disaster Risk Management held in 2001, and IDRiM (2) the second in 2002, IDRiM (3) the third in 2003, and IDRiM (4) the fourth in 2004, respectively.

(b)Kasology

Sustainability risk	Kasology(1)	Kasology(2)
S	decline of community	financial bankrupt
V	(small) village renewal	community business
C	public-private partnership	village-city exchange

In the above Kasology (1) refers to the first Conference on Kasology International held in 2003, in Chizu, Tottori, Japan, and Kasology (2) refers to the second in 2004 in Arizona, USA.

(c) CRREM

Sustainability risk	Drama Theory (CRREM) <Persuasion Dilemma>
S	persuasion failure disaster
V	persuasion driving energy/costs
C	persuasive communication skill

(d) Kasology & IDRiM (Chizu Case)

Sustainability risk	Kasology & IDRiM(Chizu Case)
S	(1) disaster reduction (2) social life
V	(1) financial resources (2) persuasion energy (3) persuasion cost
C	(1) protest/ risk acceptance / collaboration (2) persuasion / negotiation skill

2) Kasology as Sustainability Risk Management

As exemplified in **Table 1 (b)**, Kasology primarily focuses on rural decline as survivability risk but as importantly it requires other risks to be addressed and well coordinated with survivability risk. That is, in case (1) village renewal as vitality risk, and public-private partnership as communication risk. This case could include a variant of governance scheme where more initiative is taken by the local government such as introducing appropriate spatial planning and management. Case (2) represents such a situation that a small municipality is facing a very serious budgetary deficit resulting in financial bankruptcy. To overcome this hardship the municipality has to cope with vitality risk (by community business or social entrepreneurship, for example), and also with communication risk (by promoting village-city exchange activities, e.g.) If they fail, it might be the case, particularly in Japan that the municipality will be challenged by the political pressure from the higher level of government in administrative hierarchy to become amalgamated with a larger municipality.

It is interesting to add that in **Table 1 (d)**, case is made of an overlapping situation of both Kasology and IDRiM issues taking place at the same time.

3) CRREM as a Methodology of Sustainability Risk Management

The central concern here is rather methodological. If we highlight the development of a methodologically leverage to enhance coping capacity to

resolve conflicts, the common meta-problem structure again merits analytical attention. Among many game theory and conflict analysis methods, one theoretical model called Drama Theory is focused.

Drama Theory can be interpreted as a method of making the implicit knowledge of different types of internal, psychological dilemmas explicitly treated. The tension mode of three cardinal functions in the Vitae System triangle (modeled as an actor or character) being simultaneously activated and coordinated correspond to the active end of a Drama Theory Dilemma, whereas complementary modes of relaxation of at least one of the three cardinal functions, correspond to inactive ends of that Dilemma (see Bryant, 2003).

To take an example of Persuasion Dilemma as shown in **Table 1 (c)**, if the agent (called Character) can timely coordinate (synchronize) three cardinal functions as sustainability risks, it is interpreted to become a tough side of its “stance” as being “oppressed” (Bryant, 2003). This indicates that there can be different shades of Character’s coping capacity to influence others, and their possible combinational patterns produce alternative dilemmatic settings where collaboration is eventually sought after.

7. Illustrations from Field-based Studies

1) zero-to-one village renewal movement

Since 1985 the author has long been involved in the field observations and studies in the municipality of Chizu-cho, Tottori, Japan. This case area has been

going through a series of grass-root vitalizations and social innovations under the initiatives of a local catalyst-led resident group (originally called CCPT and later practically dissolved into a loose social network of motivated individuals). Particularly the last decade (1997-2007) has seen an impact making village social innovation venture called “zero-to-one village renewal movement (zero-bunno-ichi Muraokoshi Undo)” (For this see Sugiman, 2007). This was a challenging social experiment first proposed by the catalyst group and adopted by the municipal office of Chizu. The target villages were fundamental units of neighborhood communities which currently consist of the municipality of Chizu and most of which have long been existent even since (some points of time in) the Tokugawa Shogunate government period (1603-1867).

In the author’s view the major objective of this zero-to-one movement was to take a first step towards the recovery of coping capacity at community level. An expected jump for a challenging and selected communities was to make a critical shift from the state of practically vanished to a modest but substantial extent, that is, from near to zero-level (symbolized by “0”) to a level of small but substantial identity (symbolized by “1”), which is exactly the reason the name of “zero-to-one” was coined for. It also connotes that it addresses a change in quality rather than in quantity, demanding a creative knowledge-to-action leverage to move an “infinite” load with “almost nothing”.

Interestingly special knowledge-to-action is also needed to find out and actually set an appropriate fulcrum for this knowledge-to-action leverage. More often than not, such expertise first belongs to a special local catalyst who has trained his/her five senses to act locally and think globally.

Evidences obtained from Chizu suggest that such special senses may well be developed by a challenger constantly and intentionally undergoing inside-out/outside-in inversion processes. Ideally such a special local catalyst can develop his/her capacity if he/she lives in a (more) open society where synergy is continuously developed through collaborations between insiders and outsiders. In reality there are some local champions who have volunteered to take long-enduring challenges and changed the local society into a more open environment. Here again the Vitae System Model offers a new perspective to interpret the role of

a catalyst challenging inside-out/outside-in inversion processes. The catalyst belongs to a particular inner (home) community corresponding to a triangle unit of Vitae System (see Fig. 1) but is able to imagine and communicate with other external communities corresponding to another triangle unit of Vitae System. Moreover the catalyst has been trained to take a bird’s eye view of different triangle units of Vitae Systems interconnected and networked (see Fig. 2). Inside-out/outside-in inversion processes are interpreted as the processes of a person transiting from one’s own triangle to another either in imagination or actual travel together with flying up from one’s own and taking a bird’s eye view of the networked triangles including one’s own. Beside a catalyst who belongs to one’s own community it is also instrumental to involve outsiders in making another kind of inside-out/outside-in inversion. Chizu has been accumulating evidences that scientists and experts who have also volunteered to provide their external knowledge have taken a substantial role in helping local champions to train themselves into an expert of inside-out/outside-in inversion.

2) Hayase Village’s latest case of IDRiM, Kasology and CREEM

The zero-to-one village renewal movement has paved the way for promoting further resident’s initiatives to actualize multi-stakeholder knowledge-action developments in different communities which have participated in this decade-long movement. Just to mention one of the latest achievements, Hayase village in Chizu town has recently completed implementation of a mini-scale public-private partnership project characterized as a combination of IDRiM, Kasology and CREEM governance issues.

- i) In October, 2004, a typhoon attacked the municipality and exposed a large rock from the beneath of an uprooted tree on the hill side of a bush located near Mr. A’s house. The bush is owned by Mr. B from a local “reputable family.” Mr. A immediately became aware of high rock-falling disaster risk and this was also recognized by Mr. B. They as individuals were, however, not able to take any proactive action to reduce or remove the risk.
- ii) The municipality office was approached by Mr. A about this risk management problem but was

- not able to come up with any support or mitigation countermeasures on their part, since they judged the problem simply as a private issue.
- iii) The village self-government association had just been newly established by reorganizing its former traditional, inactive community organization, as a significant outcome of its decade-long zero-to-one movement. They timely took initiative and agreed to mainstream the issue into their common-interest agenda by offering partial coverage of the entire estimated costs.
 - iv) This initiative (facilitated by a local catalyst, Mr. C) has helped the municipality join this small-scale multi-stakeholder-involving venture for the benefit of the whole community as well as its potential positive impact on the rest of the town. They decided to provide them with some subsidy to vitalize the community and town, rather than to directly mitigate disaster risks.
 - v) As a result in August, 2007 all stakeholders successfully agreed to much up a whole spectrum of one's own knowledge to a collaborative action, and a construction work started and ended; the rock was removed. Thus an implementation came into a real shape by way of Vitae System triangle coordination and networking.
 - vi) The outcomes include a cost-sharing rule tentatively set and applied, the village self-government association which has increased its solidarity and quality of governance, and the concerned individuals who have become more confident in their active roles in their community. The municipality has also gained new administrative knowledge to promote synergy by way of encouraging integrated sustainable management as symbolized by a combination of IDRiM, Kasology and conflict resolution (CRREM)
 - vii) All this provides strong evidence to believe that both the concerned village community and the municipality have increased their coping capacity.
 - viii) The Vitae System Model is found to be useful in qualitatively formulating and analyzing the processes of enhancing coping capacity through a series of multi-stakeholder-involved community activities.

7. Conclusions and Further Steps into Future

This paper has discussed both the need and some prospective approaches for scientifically addressing coping capacity to advance sustainability. Though yet a totally unexplored area of research and scanty of scientific commitments made, "coping capacity" and its related notions should receive further attention and appreciation as the hotspot of managing sustainability risks. The Vitae System model should be further examined and extended, particularly in relation to operationalization for a wide area of practical cases.

To complement the foregoing discussions and findings, two related research concerns of the author's are briefly mentioned.

1) Benefiting from and Accommodating Sen's Capability Approach

Sen's Capability approach addresses human well-being by focusing freedom of choice, individual heterogeneity and the multi-dimensional nature of welfare (Sen, 1979).

In this conceptual framework Nassbaum(2000) has proposed ten capabilities, i.e., ①Life, ②Bodily health, ③Bodily integrity, ④Senses, imaginations, and thoughts, ⑤Emotions, ⑥Practical reason, ⑦Affiliations, ⑧Other species, ⑨Play, and ⑩Political environment. In author's view Sen' capability approach is construed as a broader and more general framework for the above discussed our coping capacity conceptual model. For instance the primary outcomes of Chizu's zero-to-one movement activities are the changed society which underwent democratization and opening up of the communities to outside, resulting in more freedom of choice, individual heterogeneity and the multi-dimensional nature of welfare. In other words Sen's capability is considered a "slow parameter" of what may characterize the synergetic dynamics of the whole social system in question, whereas our coping capacity model serves as a "fast parameter". Notably, common critiques of Sen's capability approach include its preventive nature from having practical and operational significance as well as its multi-dimensional, counterfactual, normative nature. Most of the critiques may also apply to our coping capacity approach. It is highly likely that much parallelism will be further uncovered between the two conceptual models by taking research chal-

lenges to overcome such difficulties

2) Going beyond Maslow's Model

Maslow's hierarchy of needs is often depicted as a pyramid consisting of five levels (Maslow, 1943): the four lower levels are grouped together as deficiency needs associated with physiological needs, while the top level is termed growth needs associated with psychological needs. It is noted that there is a strict hierarchical order assumed. "Deficiency needs must be met first. Once these are met, seeking to satisfy growth needs drives personal growth. The higher needs in this hierarchy only come into focus when the lower needs in the pyramid are satisfied. Once an individual has moved upwards to the next level, needs in the lower level will no longer be prioritized (Wikipedia Maslow)." The assumed hierarchical structure with respect to the echelon of pursuit of fundamental needs is much arguable. For instance, what happened in 2005 to New Orleans in the Hurricane Katrina Disaster seemed to be quite inconsistent with what the theory tells: A large portion of individuals who were believed to have met deficiency needs were found to be not exactly so; many were highly incapable of handling such a contingent situation which accidentally challenged individuals to demonstrate if they have enough capacity after having met lower-level needs which are thought of as fundamentals already guaranteed in one of the most civilized societies. Another evidence is the continued process of rural decline and shrinking community occurring in Japan and other developed countries (which is exactly the main theme of "Kasology") since it is considered as a problem of community's survivability linked to diminishing its vitality and communication amidst much wealth of society.

In contrast, the Vitae System Model claims that (i) meeting fundamental needs should be closely linked to building coping capacity by integrating three cardinal functions, (ii) there are incremental/gradual steps to upgrade one's coping capacity but such processes are rather adaptive and not hierarchical, (iii) enhancing coping capacity by cardinal function integration is context-dependent, and (iv) one's coping capacity has two mutually complementary dimensions, self-independent, and inter-self dependent.

8. Conclusion

In conclusion the paper has emphasized the necessity of scientific challenge for society under sustainability risks, and prospective approaches to address coping capacity, collective knowledge and action to change by use of the Vitae System Model have been discussed. The new scientific area is proposed to be called "Implementation Science." Since the time the first draft of this paper was presented some developments have been so far made to concretize more from conceptual to a level of make it more operational (i.e., operationalization). For instance an attempt has been made to apply the conceptual model of the Vitae System to a flood evacuation under survivability-critical state (Yu et al, 2010).

It is admitted, however, that the above arguments in favor of the Vitae System Model should receive further rigorous examinations and critiques from social and human sciences which have their own sound theoretical foundations as well as field-based findings. What should be stressed is its potential power to provide a frame of reference to enrich the notion of sustainability and to link together seemingly remote areas of research (such as IDRiM, Kasology and CREEM) which may altogether contribute to the development of sustainability risk management.

REFERENCES

- Okada, N. (2006) City and Region Viewed as Vitae System for Integrated Disaster Risk Management, *Annals of Disaster Prevention Research Institute, Kyoto University*, and No. 49B: 131-136.
- Okada, N. (2007) A Scientific Challenge for Society under Sustainability Risks by Addressing Coping Capacity, Collective Knowledge and Action to Change: A Vitae System Perspective, presented at the International Symposium on Vitae System, Kyoto University.
- Yu, L., Okada, N. Shen, D., and Li, S. (2010) Vitae System based agent modeling and simulation of survivability-critical evacuation in underground flooding, *SMC-IEEE*, 10-13 Oct. 2010 3133 – 3138.
- Lovins, A. et al (2003) *The Natural Advantage of Nations-Business Opportunities and Governance*

- in the 21st Century, Erathscan, London.
- Bryant, J. (2003) *The Six Dilemmas of Collaboration-Inter-organisational Relationships as Drama*, John Wiley & Sons, West Sussex, England: 136-173.
- Sen, A.K. (1979) 'Utilitarianism and Welfarism', *The Journal of Philosophy*, LXXVI: 463-489.
- Nussbaum, M. C. (2000) *Women and Human Development: The Capabilities Approach* (Cambridge University Press, Cambridge).
- Sugiman, T. (2007) *Phase Transition in the Development of 'Communication' of the Vitae Systems: Revitalization of a Rural Depopulated Area in Japan*, to be included in this Extended Abstract Booklet on ICVS, Kyoto.
- Maslow A.H. (1943) *A Theory of Human Motivation*, *Psychological Review* 50:370-96.
- Wikipedia, Sustainability <http://en.wikipedia.org/wiki/Sustainability>
- Wikipedia, Maslow http://en.wikipedia.org/wiki/Maslow%27s_hierarchy_of_needs