A SUGGESTED VIABLE SYSTEM MODEL FOR SPACE SCIENCE AND TECHNOLOGY DEVELOPMENT IN INDONESIA

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Abstract

Since 2002, the author has run a research project having three research questions. The first is to investigate whether a western systemic approach can be successfully used to define solution of complex, pluralist and coercive problems in a developing eastern world country such as Indonesia. The second is to examine whether the generated solutions will be acceptable to the stakeholders. The third is to explore whether systems approach can be used to transform high values and goals of Indonesians held within the state philosophy Pancasila into realistic and acceptable actions. The case study is the micro satellite development activities, which then abbreviated as Sipesmik (Sistem Indonesia Pengembangan Satelit Mikro = Indonesia system in developing micro satellite).

Using a combined of systems thinking and actions research, the author has developed models. One of those models is a Viable System Model (VSM) for Sipesmik, which becomes the discussion focus of this paper. To provide a general view on Sipesmik, its root definition is presented at the opening, followed by a short review on VSM, a VSM view of the present situation, and the suggested generic VSM. The ending part presents models validation result that stimulates the author to design a less radical approach of VSM for Sipesmik.

Keywords: System Thinking, Viable System Model, Space science and technology development.

1. INTRODUCTION

On the 3th - 4th of February 1998, Depanri (The Space Council of Indonesia) organized the 'First Indonesia National Congress in Space'. The congress recommended the President of the Republic of Indonesia as the Chairman of Depanri to promulgate five manuscripts that contained space policies for Indonesia. One of those manuscripts is the Indonesia National Concept on Space (INCS). In accepting the recommendation, to be Chairman, on the 10th of December 1998 the President promulgated the manuscripts (see Depanri, 1998).

The INCS states that the development of the *national space* of Indonesia will be carried out through the development of its seven components: *human resources, manufacture industry, service industry, science and technology, natural resources, political and legal aspects and institutional aspects.*

Lapan functions as the Secretariat of Depanri, and has appointed the author to assess the development of one of those components i.e. *science and technology*. The initial

approach to assessing the problem was influenced by a perspective that space science and technology development is a complex, pluralist coercive situation. To cope with this situation, the Critical System Heuristic (CSH) (Ulrich, 1993) and the Soft System Methodology (SSM) (Checkland and Scholes, 1990a, b) were combined. A list of questions was designed to collect qualitative data of 'what is' and 'what ought to be' the system, from those who are involved in and affected by space science and technology development process. Assuming that not all respondents were familiar with systems thinking, a hint of an engagement process (Ledington and Ledington, 2001) to systems thinking using the Interactive Model of Innovation Process (Manley, 2001) was implemented.

The 'what is' and 'what ought to be' data became consecutively input for developing the 'Rich Picture' and the 'Root Definition' models of the situation. Based on the collected data the Viable System Diagnostic (VSD) (Beers, 1984) was used to develop Sipesmik organization model. These models were then expanded using the System Dynamics (SD) (Forrester, 1994a, b) to discuss possible ways of 'how' to obtain the required end result (models). The resultant models were then validated with the help of respondents to evaluate the models based on their judgment.

2. THE ROOT DEFINITION OF SIPESMIK

Sipesmik tasks include space technology innovation, food and environmental management, and community involvement processes. Figure 1 shows the root definition of Sipesmik and figure 2 presents a more detailed analysis of that root definition. These figures show the perceived main actors/ participants in Sipesmik processes (executors, owners and clients), as well as the three main functions of Sipesmik: setting performance standards, monitoring and controlling and the main processes.

Figure 1 also shows that most of data needed to monitor Sipesmik come from Sipesmik tasks and all participants as individual, institutional or group. Performance standards hold the desired target of Sipesmik, they are input for the monitoring systems and they should be set up by all participants (owners, executors and clients). Draft policies (including draft performance standards) of the system are prepared by executors, submitted to owners, exercised and established by the owners, however the clients have the right to help change them. The desired outcomes include science and technology, sustainable foods, ecological as well as changing in social, regulatory and institutional practices. The latter points will need significant shifts in public and organizational norms – a paradigm shift. The constraints indicated in the root definition consist of two types the fixed constraints that the management can do almost nothing, and the second is those that management have to create solutions such as the lack of national commitment, national bleu-print of space activities, and pessimism of farmers and fishermen regarding the will of government to create and maintain sustainable food.

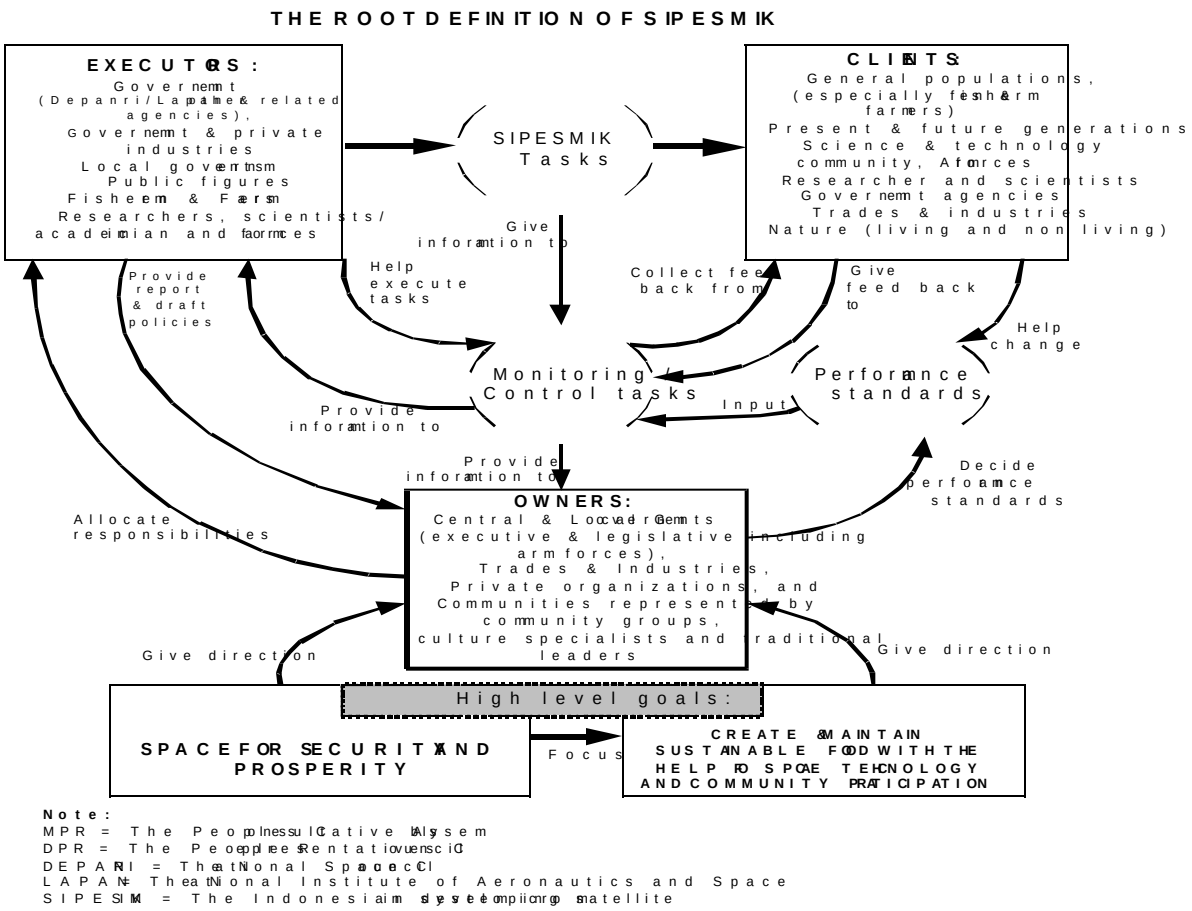

Figure 1: The Root Definition of Sipesmik

Figure 2: Relationship feature of all elements of Sipesmik

3. THE VIABLE SYSTEM MODEL (VSM)

Beer (1984) models the information flow within an organization in order for that organisation to learn, adapt and remain viable, which model is named as the VSM. Some of the information that flows between the member systems within a VSM is policy requirements, accountability, audit data and performance feedback. Information flow within VSM is recognized as communication within and between five separate 'systems' within the organization and with its environment (Tepe and Haslett, 2002).

In the VSM, a 'viable' system is one **capable of separating existence** in a specified environment (Waeldi, 1989), and one that is **capable of responding to changes** in the environment even if those changes were not foreseen when the system was designed (Jackson, 1991a). Since the VSM has to be used in a complex environment, therefore **it must be able to cope with the above two changes**. So that, the state of a viable system must be conform to the state of environmental complexity. Since the management on its own is incapable of conforming to this complexity, therefore the **organization itself must be designed to cope with such environment** (Espejo, 1989). For this purpose, the organization's **information flows, control, and structure** must therefore conform to the environmental complexity. Figure 3 shows an example of VSM scheme.

A VSM consists of five functional subsystems (Haynes and Stewart, 1993; Hutchinson, 1997) as the following:

a) Interacting with the external environment.
b) Stabilizing internal operations.
c) Providing necessary functions (3* = auditing operations).
d) Creating appropriate vision and strategies.
e) Providing legitimacy.

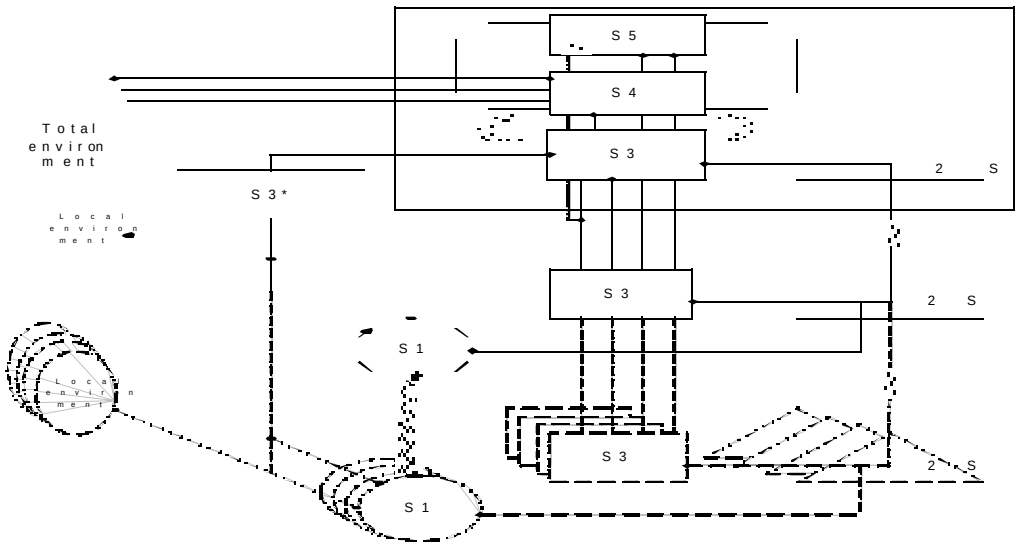

Figure 3: Five functional subsystems of VSM
(Source Flood and Jackson, 1991p. 91)

The above subsystems could also be identified as the five system functions that should be adequately performed in an organization:

a) Implementation or operational units = system 1 (S1)
b) Coordination and or supporting units = system 2 (S2)
c) Control or management (3* auditing) = system 3 (S3 and S3*)
d) Development and or intelligence = system 4 (S4)
e) Policy makers = system 5 (S5)

Description of each of the said sub system is as follows:
S1 is the operational unit of an organization (Tepe, Haslett, 2002), it 'does' what the system 'has to do'. S1 automatically adapts its environment and optimize its ongoing business (Schwaninger, 2001). It interacts with S3 in a continual feedback loop of receiving resources, and provides in returned the accountability for their use (Beer, 1985). Within an organization there are several S1s that communicate with one another as well as with their respective S3s within the environment in which they exist. In normal situation, there is no direct communication from S1 to S5, but in emergency cases S1 has the obligation to send algedonic signals directly to S5 (Tepe and Haslett, 2002).

S2 is usually recognized as the information systems, the internal service providers and the coordination teams, but also includes cultural elements such as standards of behaviour (Schwaninger, 2001). Therefore, a VSM provides support such as information, communication and processes for issues common to all S1s. It is also used to co-ordinate various S1 units by providing stability and conflict resolution through reducing choice and attenuating variety from the environment as Beckford (1995) calls the '*organizational glue'*. It reflects managerial policies and decisions but does not make them (Tepe, Haslett, 2002).

S3 essentially interfaces the S1 and the policy authority S5. Its primary function is to control the S1 activities by managing the 'resource bargain' that ensures S1 performs the organization's functions (Tepe and Haslett, 2002) that has deemed appropriately defined by S5. Flood and Jackson (1991) describe this system as the interpreter of the policy decisions of higher management. It also makes certain effective implementation of the policy through allocating resources to the parts of S1. By this way, it provides the control function that ultimately maintains internal organisational stability so that it is commonly identified as the 'management' of the system.

S3 which function is to investigate and validate the information flow between and among the systems is identified as S3* that is usually called the auditor. It provides information to S1 management about its own functions but in parallel provides this information to S4 and S5 (Beer, 1985).

S4 acts as the system intelligence. It monitors the environment and helps the organization adapt and plan for the future (Vidgen, 1998). In principle, S4 mainly communicates with the policy maker S5, but in a recursive structure, each viable group within an organisation needs its own intelligence to interpret how the environment affects its associated parts of the organisation.

S5 is responsible for policy that defines of 'what is Sipesmik going to do'. It establishes policy in light of competing demands between the present and future, and

between internal and external perspectives (Schwaninger, 2001). Beer (1985) writes that there is legal and corporate requirement flow from senior management to its juniors that in response they provide accountability report.

A VSM in a recursive structure each viable organisational unit has embedded within it the individual structures of its organization, not unlike what Tepe and Haslett (2002) call a series of Russian dolls. This because a recursive structure requires every viable unit within the organization is responsible for the success of the mission and responding challenge coming from the environment (Tepe and Haslett, 2002). This includes accessing appropriate information and services, and acquiring intelligence and performance feedback from internal and external environment. Anyhow, each viable unit must make these decisions in light of the system policy conveyed from the higher recursions in the organisation. The S3* with its independent reporting to management should ensure that this happens as designed.

According to Beer (1985) each of organization's systems must provide attenuation or amplification of the variety in their own activities and information flows so that the activities match the variety and complexity of the environment around them. Any variety not controlled in this way is construed as 'residual variety' and must be 'managed' by the organisation. Disobeying this will result in the potential for the organisation to be overwhelmed by the complexity and cease being viable.

To sum up this section it worthwhile to quote the statement of Jackson (1993a, p 571): '*VSM is a sophisticated model of great generality, pinpointing various systemic / structural constraints which must be observed if an enterprise is to succeed as an adaptive goal seeking entity'*. Even though, some criticisms present to value the VSM, such as given consecutively by Jackson (1989) alone and Flood and Jackson (1991) as the following

a) In practice, the VSM could become fixed and inflexible, and encourage autocratic management practices and it's emphasize is on organizational structure.
b) It might be difficult to apply in practice because of the resistance it may invoke with the entrenched structure.

However, certain examples of success usage of the VSM can be listed as follows:

a) A model of organizational structure of San Francisco Zoo (Dickover, 1994)
b) Organizational structures in an entertainment group and a motor dealership (Flood, 1995b, p.146-177)
c) Corporate alignment of Occupational Health and Safety (OHS) (Tepe and Haslett, 2002).

3. MAPPING OF THE PRESENT SITUATION ON A VSM

It is illustrative to examine the existing structure of Sipesmik organization in terms of a VSM, since there is not yet realised. Figure 4 presents a model that outlines the present situation. This model was developed from the data collected by interviews and documents gathered from respondents. This model shows the policy, arbitration, and decision making level (S5) to be the Depanri (the national council for air and space affairs) chaired by the President. The level which has the task of obtaining the intelligence about the environment and distributing information up and down the

system (S4), is handed by the Secretariat of Depanri that has two working groups. The first is usually called “Kelompok Inti” (core group) representing upper management of institutions involved in air and space affairs (member of Depanri). The second is usually called “Kelompok Kerja” (working group) that consists of two working groups: technical working group and legal working group. However, this collection of information is carried out in a compartmentalised manner, which is a function of the departmentalised responsibilities of institutions and their associated ministers. Furthermore, most of the problems handled by these groups are still limited to what discussed in the United Nations Committee on Peaceful Uses of Outer Space (UNCOPUOS).

A program that invites public awareness on the idea of developing micro satellite is a national space congress, when people discussed the INCS implementation (see section 1), which was followed up by Lapan with initial effort of developing micro satellite. Therefore Lapan can be seen or belongs to S3, in the Sipesmik concept. Furthermore Lapan also established an inter-department team for this project (Lapan, 2002).

The above description shows that implementation of principles of S1, S2 and S3 is still missing and as a result there is no recursion structure and so do the requisite variety. There is S3* run by the state auditor (Badan Pemerika Keuangan = BPK), but its duty still focus on financial accountability. Although lately, it tries to uncover success indicators of management other than financial but still is not in a comprehensive manner. BPS (the statistic central bureau) monitors social economic indicators but the author does not yet find its special concern on monitoring the equity and justice, while BPHN (the agency for national law development) monitors the national laws and regulations, but the author does not yet find its special concern on monitoring the distributive, interactional and procedural justice in a comprehensive manner. Bapedal (the agency for controlling the environment) monitors the environment indicators. Furthermore, there is no communication-link between BPK, BPS, BPHN, Bapedal and Secretariat of Depanri like that is supposed to do by S3* and S4. There are ministries and departments that are members of Depanri but they do not yet administered as the relevant part of Sipesmik wether S2 or S3 principles. They participate in core and working groups, also in Sipesmik national team. But no factual support that is supposed to do like S2 principle.

This means those departments and ministries are acting independently of one another with the consequent lack of cohesion, and varying amounts of success. There is also no control over their conformance with an overall national strategy. The control function (S3) for all of these teams needs to be fulfilled. There are facilities spread out over the country, which with the owners agreement can be mobilized as S2 either at national or lower levels such as laboratories and experts own by Bapedal, and remote sensing system own by Lapan, BPPT (agency for technology assessment and application) and Bakosurtanal (agency for survey and mapping), Department of sea and fisheries, Department of agriculture, Department of public works and several universities like University of Gadjah Mada (Jogyakarta), Bogor Institute of Agriculture and Bandung Institute of Technology.

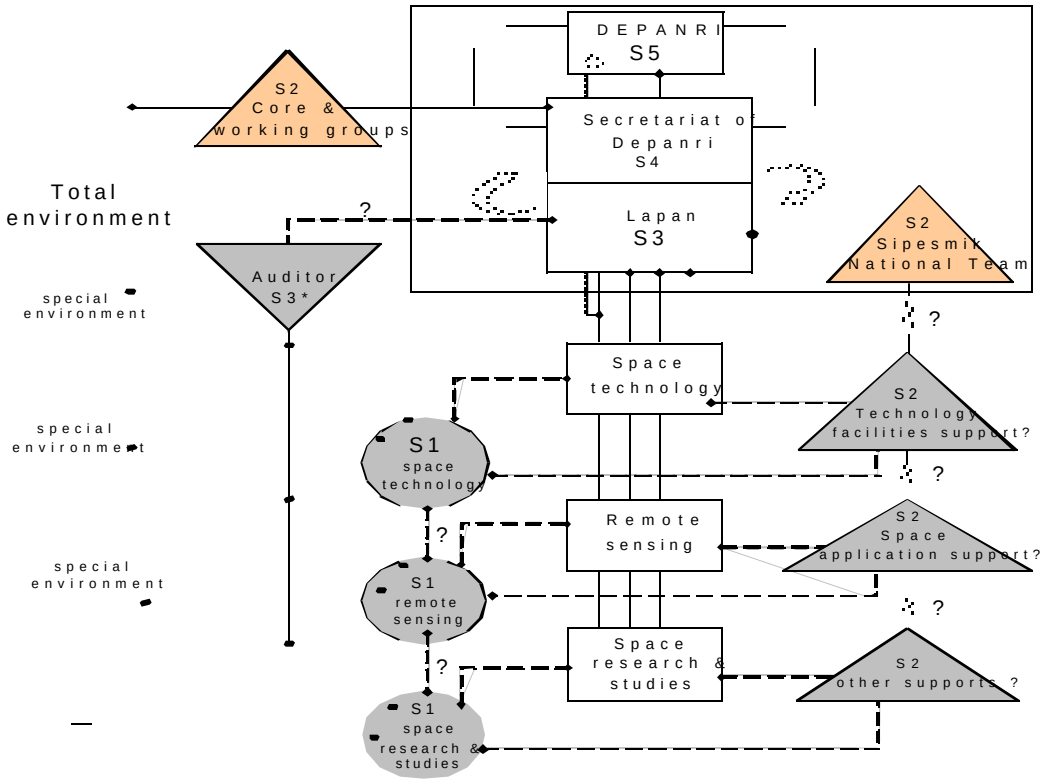

Figure 4: Present situation of Sipesmik seen from VSM point of view (Adapted from Flood and Jackson, 1991, p. 91)

4. A SUGGESTED GENERIC VSM FOR SIPESMIK

Discussing the possible organization of Sipesmik, some respondents are at the opinion that assuming **different morphological unit has different natural capability to support food production** therefore Sipesmik organization should acknowledge the presence of various morphological situation. Based on its morphological situation, Indonesia was suggested to be classified into two parts divided by the 'Wallace Line' (Woodward, 1997). It passes between Bali and Lombok islands and between Kalimantan and Sulawesi then continues south of the Philippines. The western part shows more Asiatic nature whilst the eastern part presents more Australian nature. Based on its morphological feature, the western part can be divided into three groups: Sumatra, Kalimantan (Borneo) and Jawa-Bali. The eastern part can be divided into four groups: Sulawesi (Celebes), Maluku islands, Irian Jaya and Nusa Tenggara islands (excluded Bali). So that they suggested establish seven clusters within Indonesia region, three clusters of western part and four clusters of eastern part. Each cluster becomes a CNMU (Cluster of Natural Morphological Unit). Each cluster may have a number of NMU (Natural Morphological Unit) such as a river basin, volcanic plain, karst region, and catchment area.

Sipesmik's S1, as the operational units within Sipesmik should be accountable to the organisation for its Sipesmik performance therefore this system is where indicators of success of Sipesmik are controlled. S1s at all recursions of the organisation,

implement the policies defined by S5, resourced by S3, and benefit functional services provided by S2s. Based on the collected data their tasks are:

a) Develop space science and technology,
b) Create and maintain sustainable foods,
c) Manage natural environment,
d) Increase and maintain high economic productivity,
e) Change socio cultural practice
f) Regulate the Sipesmik
g) Change institutional practice and
h) Increase and maintain high local government participation

Sipesmik's S2 should provide functional services for all S1s so that they can optimally perform their duty. S2 at national level should support all S1 not only at national level but also at cluster and unit levels. S2 at cluster level should support not only to its associated CNMU but also to its associated NMU. The functional service needed by each level of S1, might differ one another. For example, S1 at national level for developing space science and technology needs facilities to execute research and development, production/construction, and operation of space system. Whilst S1 at CNMU or NMU level, for the same duty needs facilities only for space technology application, such as space remote sensing and ground truth. Therefore, the S2 activities differs one another depending on the level and type of organisation and the recursion within the organisation, and they may be owned by the organisation itself or acquired from an external service provider. A preliminary list contains 11 functional supporting entities that include:

a) Space science & technology innovation
b) Natural environment management
c) Foods management
d) Economic production data base
e) Natural resources database
f) Earth resource monitoring
g) Space debris monitoring
h) Transportation
i) Communication
j) Training and education
k) Indonesia regulation data base

Sipesmik's S3 should be the system's management. It interprets the policy decisions concerning Sipesmik for the S1s and ensures that adequate resources are available for compliance with the policy. It has to monitor Sipesmik performance produced by the S1s that each of them has determined indicators of success. Whilst, S3* provides additional independent audit information concerning: Sipesmik images, the number and nature of objections/ complaints, acceptance levels, economic productivity levels, amount of funding, level of waste, distributive justice, procedural justice, interactional justice, space products, food products, natural environment, space technology innovation cycle, food products economic cycle, social change, natural environment management cycle and Sipesmik management cycle. This information has to be informed not only to S1 but also to S4 and S5.

Sipesmik's S4 should monitor the environment consisting of political, legal, socio cultural, science and technology, and natural forces. Based on this monitoring result and report from the auditor (S3*), S4 provides suggestion to S5 on how Sipesmik should adapt and plan for the future. It should be noted that, at a recursive structure, all systems at every levels in the organisation also require intelligence service appropriate to their activities.

Sipesmik's S5 should establish policy on how to use space for security and prosperity of the country, especially in creating and maintaining sustainable foods with the help of space technology and community participation. This policy must be communicated throughout the organisation in order for the lower recursions to reflect this policy in the context of their own activities.

VSM for Sipesmik should be recursive that each viable organisational unit has embedded within it the individual structures of its organization, not unlike what Tepe and Haslett (2002) call a series of Russian dolls. At national level, a CNMU group as S1 should have a complete S1 - S5 structure within it. Also at cluster level a NMU group should also have S1– S5 structure within it. Refers to Espejo et al (1996) each CNMU or NMU group should have its own management team responsible for control and access to services that provide coordination and intelligence gathering processes. This is to ensure that down to the smallest viable workgroup, each unit has the policy, intelligence information, control functions and coordination services to do the work that needs to be done in accordance to its environment. As Espejo et al (1996) write that recursion provides the organisation with the ability for the small groups to make 'policy' about how to handle the problems they encounter in their jobs and provides the flexibility to survive in complex and rapidly change.

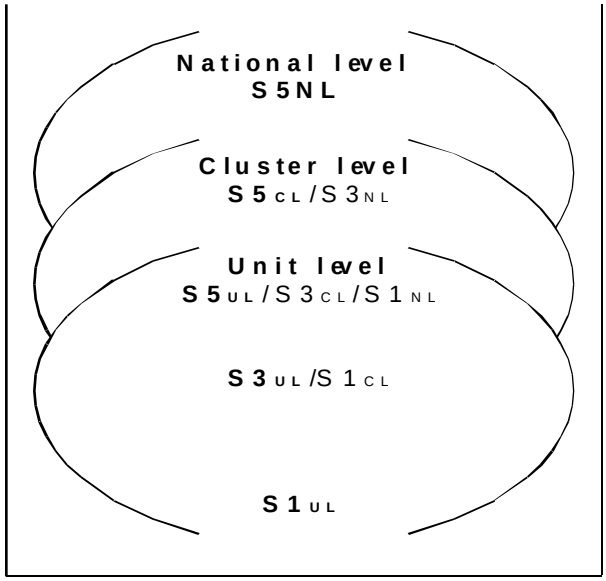

Figure 5: Sipesmik recursion
(Adapted from Tepe and Haslett, 2002)

To guarantee the consistency of policy framework, S5 at lower level should belongs to S3 at the next higher level and S1 at lower level should belong to S3 at higher level. This means S5 of a NMU group should belong to S3 at its associated CNMU group, S5 of a CNMU group should belong to S3 of the national group; S3 of a NMU group should belong to S1 at its associated CNMU group and S3 of a CNMU group should belong to S1 of national group. Figure 5 shows the whole Sipesmik recursion.

The assumption is that if higher levels S5s have conveyed their policies clearly, these lower levels of recursion will understand the organization policies and apply them to their own circumstances. This recursive structure requires that every viable unit within Sipesmik is responsible for the success of the mission and responding challenge coming from the environment. This includes accessing appropriate Sipesmik information and services, and acquiring intelligence and performance feedback about the internal and external environment. Anyhow, each viable unit must make these decisions in light of the Sipesmik policy conveyed from the higher recursions in the organisation. The audit function in S3*, with its independent reporting to management should ensure that this happens as designed.

According to Beer (1985) each of an organization's systems must provide attenuation or amplification of the variety in their own activities and information flows so that the activities match the variety and complexity of the environment around them. Any variety not controlled in this way is construed as 'residual variety' and must be 'managed' by the organisation. Disobeying this will result in the potential for the organisation to be overwhelmed by the complexity and cease being viable. The author believes that food issues not controlled, or controlled with less variety than the possible causes will overwhelm a country, therefore Sipesmik should implement such a requisite variety concept that reflects how an organisation deals with complexity in its environment.

Figure 6 shows a suggested VSM for Sipesmik. This is a generic model that can be implemented in all levels of recursion. The number of S1, S2 and S3 should be adjusted according the recursion and environment.

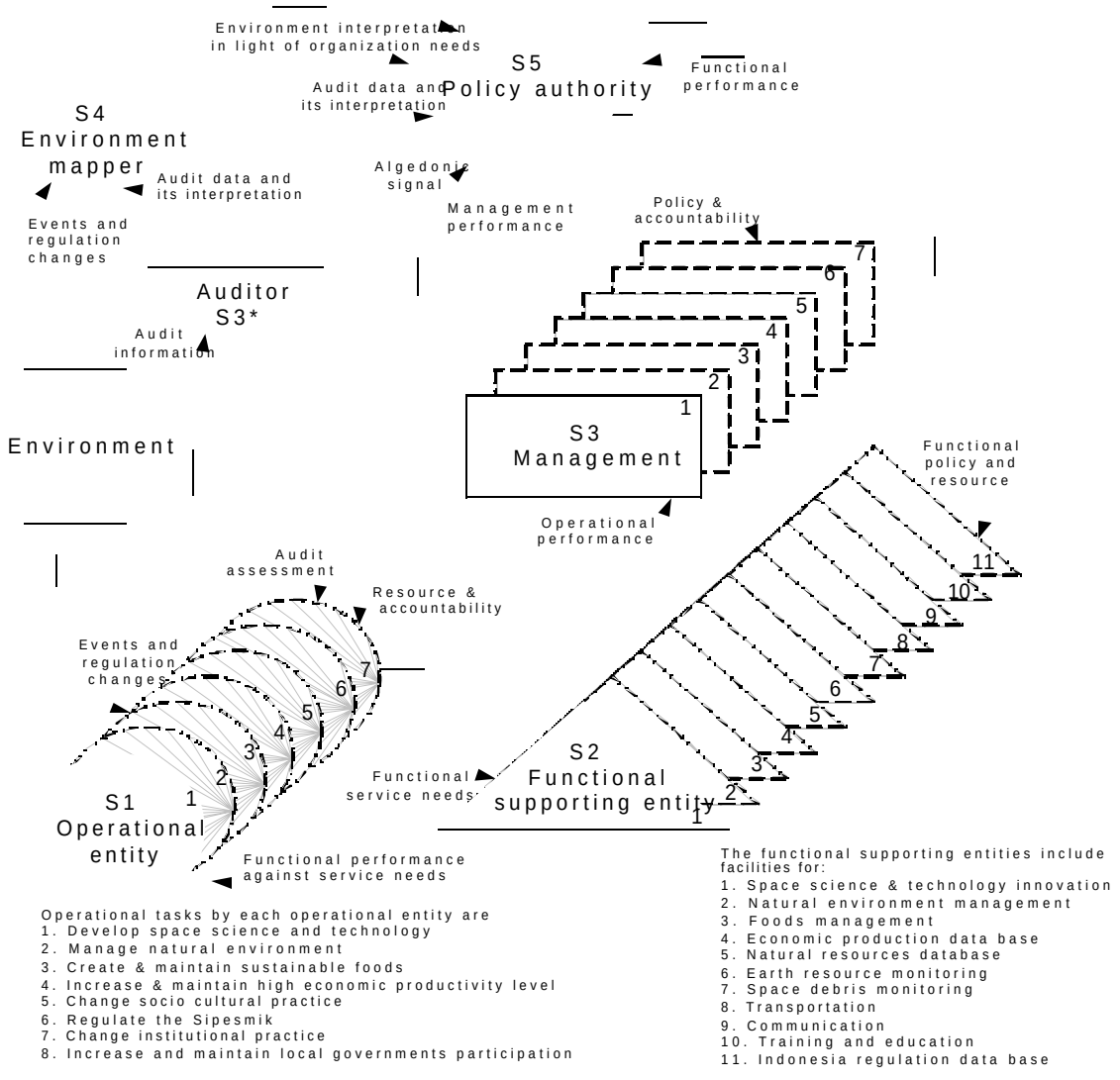

Figure 6: A suggested generic VSM for Sipesmik

The overall information flow within Sipesmik can be resumed as follows: the information that flows through out the Sipesmik should provides this organization the method for monitoring a sustainable development performance. Information concerning indicator of success and audit data flows from S1 to the other systems as proof of performance and evidence of accountability. S2 uses this information to interpret the services required and to affirm the organization attitude to sustainable development. S3 uses the information to determine the adequacy of performance and adjust the resources for S1s. S4 compiles summary performance reports and compares these to the needs and challenges reflected by the environment. S4 uses this information to assist S5 in determining if performance is adequate and / or if policy needs to change in response to the environmental trends. This process as a whole should provides the infrastructure for Sipesmik governance and refers to Argyris (1982) it should be a continuous improvement or double-loop learning.

5. MODELS VALIDATION

The models that were validated consisted of Root Definition, Task Models, Viable System Model (VSM) and System Dynamics Models (SDM). The model validation form was comprised of 7 questions, but for this paper the author focuses only on the sixth and the seventh questions. The sixth question was designed to get the respondents' judgment on how well the viability of the models in terms of: their effectiveness, efficiency, efficacy, equity, ethicality and elegancy, using the formulas suggested by the respondents during the interview. The seventh question invited respondents give further comments.

Table 1 shows the variation percentages of respondents who judged the viability characters of the models. The percentage variation that relates to the effectiveness of the models is 77% high, 21% medium, and 2% low. This variation has a slight different with that of equity character of the models, which is 71% high, 27% medium and 2% low. The next slight difference of variation is that of ethicality character of the models, which is 69% high, 29 medium, and 2% low. The next is elegancy character, which has 67% high, 31% medium and 2% low. The two other characters have far difference variations. The first is that of efficiency character, which has 38% high, 60% medium and 2% low. This has a slight difference with the second that has 34% high, 63% medium and 2% low.

Table 1: Viability of the models
(in term of their effectiveness, efficiency, efficacy, equity, ethicality and elegancy, based on 48 respondents' judgments)

Viability characters of the models	% of respondents who judged the models as having the grade of		
	High	Medium	Low
Effectiveness	77	21	2
Efficiency	38	60	2
Efficacy	34	63	3
Equity	71	27	2
Ethicality	69	29	2
Elegancy	67	31	2

Regarding the viability of the models, there were three respondents who provided special notes. The first was a 'practical person', who did not find any of the character having more then low grade, 'since' the models are theoretical. The author agrees that the models are theoretical, since they form a methodological approach to space science and technology development management in Indonesia, but this does not mean that the models has no viable character et all. This is shown by the above respondents' judgments.

The second is the respondent who during the interview stated that all viability characters listed in the questionnaire were already included in the effectiveness character and there was no need to further detail. Due to this ignorance of the author, this respondent did not want to judge any of those characters. The third also did not want to judge any of those characters, since this respondent found that the models are pre-requisite for the success of space science and technology development in Indonesia. The author translates the latter judgment as the models having high viability.

6. FOLLOW UP OF THE MODELS VALIDATION

Observing the above validation result, the author has taken follow up actions to improve the suggested VSM for Sipesmik. The assumption made is that the less-efficacy and less-efficiency of the models were in some parts caused by the suggested VSM is the generic one that did not include the detail of each recursion, beside it should be more practical. The followings are some details and a less radical approach of VSM for Sipesmik.

a. A suggested VSM for Sipesmik at national level

As described in in section 2 the owners of the system were perceived to consist of the central and local governments (both legislative and executive including the arm forces), trades and industries, private organizations and communities represented by DPR, community groups, cultural specialists and traditional leaders. These are assumed to form S4 and S5 in the VSM for Sipesmik at the national level. The actors involved in running the system were perceived to be: government (Depanri/Lapan and other related government agencies), government and private industries, local governments, public figures, fishermen and farmers, researcher, scientist/academician and arm forces. These actors are primarily thought to form the basis of S1 to S3 in the VSM for Sipesmik at the national level. The S2 function, providing what Beckford (1995) calls the "*organisational glue* ", is filled by an integrated plan covering a state-wide natural unit classification and space system development with which those natural units will be managed to create and maintain sustainable foods, and supporting facilities for S1s can optimally perform the duty of overall system in its associated area.

The environment factors, which need to be monitored by S4 were determined to be: physical forces, science and technology forces, social forces and political and legal forces (see section 2). At the operational levels S3* should monitor: Sipesmik images, the number and nature of objections/ complaints, acceptance levels, economic productivity levels, amounts of funding, level of waste, distributive justice, procedural justice, interactional justice, space products, food products, natural environment, space technology innovation cycle, food products economic cycle, social change, natural environment management cycle and Sipesmik management cycle. S3 should

monitor the indicators of success of each task that is run by S1 in its associated working area. As suggested by respondents that there are seven CNMU, therefore at national level there should be seven group of S3 and seven group of S1. Each of those seven groups should represent one of the following CNMUs: Sumatra, Kalimantan, Sulawesi, Maluku, Irian, Nusa Tenggara, and Jawa-Bali.

b. A suggested VSM for Sipesmik at cluster level

This suggested VSM is designed to be implemented in all seven CNMUs. The number of NMU of each cluster might be different, since it depends of its morphological situation. For this purpose an S2 at national level shall help assess the establishment of all NMU of the whole country. The criteria for establishing an NMU should be defined mainly from morphological situation but practical reasoning should also be considered.

As described in section 2; the owners of the system were perceived to consist of the central and local governments (both legislative and executive including the arm forces), trades and industries, private organizations and communities represented by DPR, community groups, cultural specialists and traditional leaders. All of these compose the S5 of the cluster.

Central government at cluster level should be represented by associated provincial governments, since in the administration system of Indonesia provincial government is the representative of central government in their associated provincial area. In the case of Jawa Bali cluster, it should be represented by all provincial governments in this cluster, which consist of DKI Jakarta, Banten, West Jawa, Central Jawa, DI Jogyakarta, East Jawa, and Bali. While local governments should be represented by district governments of the associated cluster levels. District government includes executive and legislative that includes arm forces. Trades and industries, private organizations, community groups, cultural specialist and traditional leaders are those whose domiciles are in the associated cluster.

Table 2: The network of Sipesmik actors

	National Level	Cluster Level	Unit Level
S5	Central and local governments (both legislative and executive including the arm forces), trades and industries, private organizations and communities represented by DPR, community groups, cultural specialists and traditional leaders		
	Local governments represented by provincial governments	Central government represented by provincial governments,	Central government represented by provincial governments
S4	Lapan that function as the Secretariat of Depanri supported by inter-department working groups		
	Run by Lapan Head Quarter & core working group	Run by the closest Lapan regional office & core working group	Run by the closest Lapan regional office & core working group
S3, S2 &	Government (Depanri/Lapan and other related government agencies), government and private industries, local governments, public figures, fishermen and farmers, researcher, scientist/academician and arm forces.		

S1			
S3	Run by a national coordinating entity which members represent S5 of all clusters.	Run by a regional coordinating entity which members represent S5 of all units associated with the cluster.	Run by a local coordinating entity which members represents of the unit.
S3*	Run by a national auditing consortium that includes BPK, BPKP, BPPN, BPS, Bapedal, BPS, and other related institutions (private & government)	Run by regional consortium of auditing entity that includes BPK, BPKP, BPPN, BPS, Bapedal and other related institutions (private and government)	Run by local auditing consortium that includes BPK, BPKP, BPPN, BPS, Bapedal and other related institutions (private and government)
S2	All facilities necessary in support to the accomplishment of the 8 Sipesmik tasks	All facilities necessary in support to the accomplishment of the 8 Sipesmik tasks, which domicile in the associated cluster	All facilities necessary in support to the accomplishment of the 8 Sipesmik tasks, which domicile in the associated unit.
S1	All representatives of S5 of cluster level	All representative of S5 unit level in the associated cluster.	Government and private industries, local governments, public figures, fishermen and farmers, researcher, scientist/ academician and arm forces domicile in the associated unit.

The S4 should be run by regional offices of Lapan as the Secretariat of Depanri supported by inter-departmental working groups. Like at national level, the Sipesmik actors at cluster level are government (Depanri/Lapan and other related government agencies), government and private industries, local governments, public figures, fishermen and farmers, researcher, scientist/academician and arm forces. These actors should also the primarily thought to form the basis of S1 to S3 at cluster level.

The S3 should be run by representatives of S5 of the units of the associated cluster. The S3* should be run by a regional auditing consortium that includes BPK, BPKP, BPPN, BPS, Bapedal, BPS, and other related institutions (private & government) such as Survey Indonesia Corp.

The S2 functions to provide support for all S1 in their associated clusters and unit level. An S2 at cluster level shall help assess the establishment of S1 at unit level. The criteria for establishing an S1 should be defined mainly from morphological situation but practical reasoning should also be considered.

Further detail can be seen in table 2.

c. A suggested VSM for Sipesmik at unit level

A VSM at this level should also consist of S1-S5 principles. As described in section 2 that the owner of Sipesmik consist of central and local governments (both legislative and executive including the arm forces), trades and industries, private organizations and communities represented by DPR, community groups, cultural specialists and traditional leaders.

Central government at unit level should be represented by associated provincial governments, since in the administration system of Indonesia provincial government is the representative of central government in their associated provincial area. While local governments should be represented by district governments of the associated unit levels. District government includes executive and legislative that includes arm forces. Trades and industries, private organizations, community groups, cultural specialist and traditional leaders are those whose domiciles are in the associated unit.

In the case of Bengawan Solo catchment area, an NMU that spread out over three provincial regions: East Jawa, Central Jawa and DI Jogyakarta, therefore the associated provincial and district governments are those of East Jawa, Central Jawa and DI Jogyakarta, also the trades, industries, private organizations, community groups, cultural specialist and traditional leaders.

The S4 should be run by the Lapan regional offices situated in this area, which is the The Watukosek Lapan Observation Station. Also, the S3* should be run by a local auditing consortium that include BPK, BPKP, BPPN, BPS, Bapedal, BPS, and other related institutions (private & government) such as Survey Indonesia Corp. The S3 should be run by agencies and privates domiciles in this region, which are selected to participate in S1 of Sipesmik Jawa cluster, since Bengawan Solo catchment area belongs to Jawa cluster.

The S2 should be run by all facilities needed to support the 8 tasks of Sipesmik, which domicile in this region, for example PUSPIC's remote sensing facilities in Jogyakarta, which is developed by University of Gadjah Mada in cooperation with Bakosurtanal, and BPPH (research facilities for animal sickness) in Wates, Jogyakarta. Further detail can be seen in table 2.

d. A less radical approach of VSM for Sipesmik

This less radical approach holds the principles of recursion and S1-S5 principles at national level, cluster level and unit level.

Depanri and Lapan as the national institutions responsible for aeronautic and space in Indonesia, has the moral obligation to market space technology for solving human life problems in Indonesia, therefore it is relevant for Depanri/Lapan to functions as the pioneer of the implementation of Sipesmik concept. Therefore, the S5 institutional forum should be run by Depanri. For this, the member of Depanri should be enlarged to include central and local governments (both legislative and executive including the arm forces), trades and industries, private organizations and communities represented by DPR, community groups, cultural specialists and traditional leaders.

When assessing a strategic decision, Depanri should convene (a) space congresses where the whole Sipesmik actors are represented. The congress' recommendations become input for the council to make decision.

This mechanism is also valid for cluster and unit level, where Lapan regional/local office functions as the secretariat to convene cluster or unit congress. The recommendation of the congress of each level become the agreed action program of the associated unit or cluster. Topic assessment of this congress should include identification of facilities and roles needed to accomplish the 8 tasks of Sipesmik.

7. CONCLUSION

That the viability of Sipesmik models were judged by some respondents as 'medium' or 'low' grade, in some parts, was caused by the suggested generic VSM that did not provide a comprehensive view on the suggested organization of Sipesmik. Some respondents had difficulties to figure out how recursions of each level in the VSM should occur. Also, some respondents thought that accepting the suggested VSM means approve or agree to establish a new institution or department to run the Sipesmik. Based on the above findings in this paper includes some details of the recursions of each level of the suggested VSM, and provides a less radical approach of VSM for Sipesmik. Submitting this paper, the author invites advices and suggestions from the audience of the conference and later from the readers when this paper is published electronically as planned.

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