

# Constructing the Phylomemetic Tree

Case of Study: Indonesian Tradition-Inspired Buildings

Hokky Situngkir  
[hs@compsoc.bandungfe.net]  
Dept. Computational Sociology  
Bandung Fe Institute

February, 15<sup>th</sup> 2008

## **Abstract**

The paper discusses the importance of phylomemetic visualization to approach the cultural diversity in the social system like Indonesia, and thus revisit formal methodology regarding to the construction of the phylomemetic tree as an inspiration lent from the phylogenic analysis. A case of study is presented regarding to the data obtained from the diversity of traditionally inspired building-designs in Indonesia. Some future conjectures and open future analytical works in the anthropological studies are drawn.

**Keywords:** phylomemetic tree, dendrogram, cultural evolution, memetics, diversity, Indonesia.

## 1. Background

Indonesia lives in the way of life described as unity in diversity (depicted in the national motto: *bhinneka tunggal ika*). The diverse ways of life, ethnicities, religions, and even races have brought the country to become the largest country in the world living with differences peacefully. A unique geographical nature, the archipelago, has also played a major role shaping the face of Indonesia to day. A lot of factors are intertwining shaping the diversity of Indonesian people and its culture which in turn become the source of a great deal potentials for our further understanding for the human kind cultural aspects in general.

Memetics studied the case of the growing human culture in the sense of inspiration from the evolutionary perspectives. Everything that we see, feel, wear, enjoy emerges from an information unit presented by our genetic evolution (*cf.* Dawkins, 1978). Furthermore, the ways we behave sometimes influence the way genetic evolution. This is the very essence of the perceived human civilization.

As one of a place with the highest diversity in human culture, Indonesia is a very important place for acquiring human understanding about themselves, yet, Indonesian people can also learn a lot on how to maintain themselves by exploiting understanding from the evolutionary thoughts. The diverse cultural objects in the social realm of Indonesia are opening wide doors to give us a lot of explanation about humanity and its evolution in general.

A visualization of phylomemetic is aimed to see the rooted commonality between cultural objects in their features. Phylomemetic tree shows the diagrammatic view of the similarities embedded in the features of cultural artifacts while focusing in their differences. This is the very interesting features of the phylomemetic diagram and become the theme want to be discussed deeper in the paper. We will not discuss about the terms in the memetics but yet focusing on what we can study by understanding meme as the smallest information unit in human mind as the source of their productivity making cultural objects, be it songs, paintings, architectural designs, etc. Here, the notion of memetics laid upon the realization that meme can be detected in the artifacts and cultural objects. It is not laid in the artifacts, but one can observe meme by scrutinizing the artifacts (Situngkir, 2004).

The paper is structured in the following. We discuss the methodological steps of building the phylomemetic tree including some theoretical possibilities regarding to it, i.e.: the decisions for choosing cultural aspects as the basic step to have the memeplexes, the way of to transform the matrix of homology to distance matrix, and some ways to have the phylomemetic tree. As a case of study, we construct the phylomemetic tree of Indonesian tradition-inspired buildings as shown in *Taman Mini Indonesia Indah (TMII)* – a national park dedicated for Indonesian traditional and cultural heritages. A discussions is then followed the diagrammatic visualization added with some possible conjectures for future analytical works.

## 2. Revisiting Phylomemetic Tree

The steps to build the general phylomemetic tree should be conjectured to the distance matrix between artifacts. The distance of the artifacts will eventually give opportunity to visualize the clustering of the artifacts based on the observed features as the heart of the phylomemetic analysis. We can point at least three steps should be taken in the methodology, i.e.:

*First*, we should have the tables of the memeplexes as discussed in Situngkir (2004). There could possibly some ways to do this based upon the kinds of artifacts we would like to approach. One simplest way could be made is by pointing interrogative (yes/no) questions about the existence of some features and characteristics of the artifacts (Heylighen, 1993). Furthermore, more rigorous steps that can be conducted is by using some methodology by acquisition of some statistical methodology about the features. Extraction of detailed and quantitative information from the artifacts by considering certain features can also been taken. The quantitative information thus may be categorized into several groups of values from which we can have the bases of the memeplex. An exemplification can be seen as it has been shown in Situngkir (2007) on the clustering tree of some Northern Sumatera languages. The quantitative variables can be transformed into several qualities e.g. the fuzzy modeling for instance.

$$x \in R \xrightarrow{T} \{m = f(x)\} \in N \quad (1)$$

where  $N$  is finite. But it is also worth noting that if one has long sequence of memeplex, the memeplex can also be stated as series of real numbers,

$$m = \bigcup_i x_i \quad (2)$$

The latest sort of modeling would sometimes be able to yield the strong and strict phylomemetic tree but not always. It all depends on the observed artifacts.

*Second*, from the table of the memeplex we can now construct the the distance matrix among the cultural objects. In this step, we can do comparation between two memeplexes that directly yields the Hamming distance between two artifacts or do the alignment algorithm as it has been discussed in Khanafiah & Situngkir (2007). For memeplex with constituted by binary strings, the hamming distance can be measured as the numbers of different bits,

$$\delta_{\text{hamming}} = \|m_1 \text{ XOR } m_2\| \quad (3)$$

There would also possibilities that one do not do the categorization as depicted in eq. 1 – while memeplexes are obtained from the series of (quantitative-) information extracting algorithms – the correlation coefficient ( $\rho(m_1, m_2)$ ) can be used to compare memeplexes.

$$\rho(m_1, m_2) = \frac{\langle m_1 m_2 \rangle - \langle m_1 \rangle \langle m_2 \rangle}{\sqrt{m_1^2 - \langle m_1 \rangle^2} \sqrt{m_2^2 - \langle m_2 \rangle^2}} \quad (4)$$

The greater  $\rho(m_1, m_2)$  the more two memeplexes are correlated and the less it is the less correlated the two are, while the closer it is to zero, the more the two uncorrelated. Even though some works regarding to the more rigorous terms on deciding between the two are necessary for future conjectures, we could see that the two would have given us explanation of the representation of differences among memeplexes, and cultural artifacts in general. We would like to cite Mantegna &

Stanley (2000), that we would need a space for the next step of the methodology by transforming the correlation coefficient into the ultrametric distance (see also Situngkir, 2000 for some discussion about ultrametric space in market analysis),

$$\delta_{ultrametric}(m_1, m_2) = \sqrt{2(1 - \rho(m_1, m_2))} \quad (5)$$

*Third*, the obtained distance matrix can be used to build the phylomemetic tree by using the dendrogram or cladistics techniques. As it has been discussed in detail by Khanafiah & Situngkir (2006), a useful algorithm that can be used to have clearer view of the clustered artifacts is the so-called UPGMA (Unweighted Pair Group Method with Arithmetic mean). This is a popular bottom-up data clustering method used in genetics. In this tree construction technique, one assumes the constant evolutionary changes. In short, the algorithm examines the structure present in a pairwise distance matrix to then construct the dendrogram. Then at each step, the nearest 2 clusters are combined into a higher-level cluster. The distance between any of clusters A and B is taken to be the average of all distances between pairs of objects "a" in A and "b" in B. By using this method, we can examine whether our visualization has conform with some analytical observation in general.

### 3. Case of Study: Tradition-Inspired Buildings in Indonesia

The diversity of Indonesia is represented in a so called place, *Taman Mini Indonesia Indah*, a park in which the diversity of Indonesian and this has become an exemplification of our acquisition of the visualization offered by the cladistics of memes: phylomemetic tree. We listed the buildings reflecting the 26 places of old provisions of Indonesia in the administrative area of provinces.

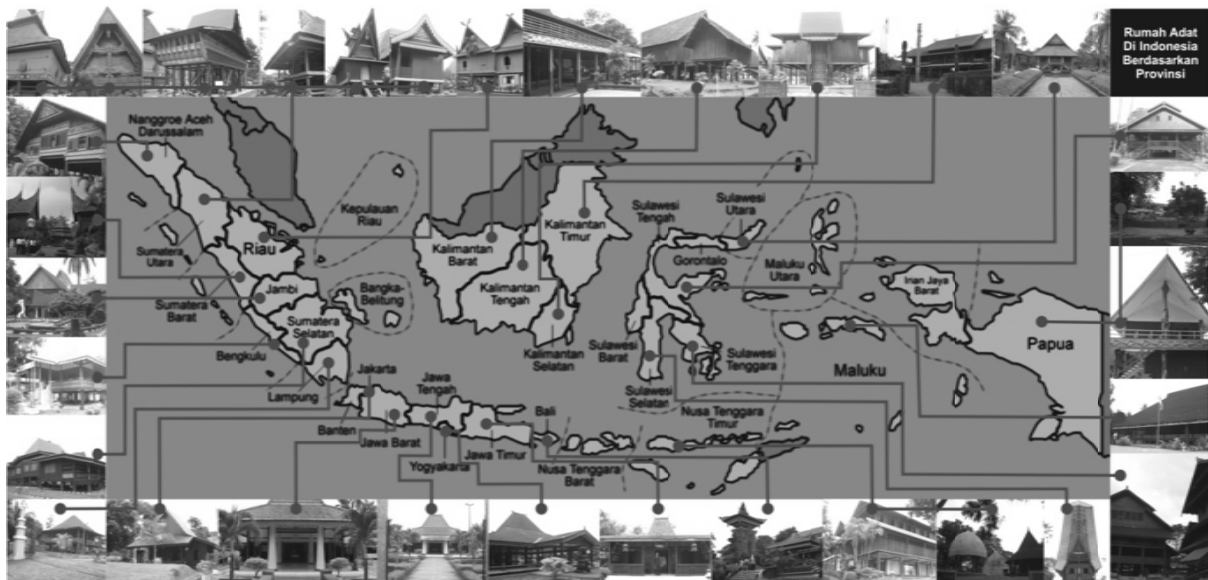


Figure 1

The diversities of architectural buildings in Nusantara

It is worth emphasizing that most of the buildings do not necessarily represent certain ethnicities. In the park, the Indonesian traditional architectures reflect the traditional houses (or palaces) of ethnic groups within the area of Indonesian local provincial administrations. Thus, the numbers of ethnicities and social identities shown in each province and consequently the objects becoming the

case of study in the paper are not exactly representing the traditional buildings of each ethnicity. Nonetheless, the architectural designs are considered to reflect the traditions in every provincial area<sup>1</sup>.

The memplexes used in the case of study are made up in series of binary digits representing yes-no questions (Heylighen, 1993 & Situngkir, 2004). The details are,

*1. Is the building can be categorized as “rumah panggung”?*

*- if yes, what kind of rumah panggung is it?*

*→ how high is building? Is it constructed for defense from predators or sea-waves?*

*- if yes, is the below spaces under the building functional, e.g.: stables?*

Probably this is one of the most important and specific feature of Indonesian traditional buildings as environmental response to Indonesian natural aspects, i.e.: archipelago in the tropical climates. “*Rumah Panggung*” is an architecture of Indonesian traditional buildings built up on stilts. This architecture keeps the rain and mud out while it allows cooling upper breezes and underfloor ventilation, discourages mosquitoes, allows movement during earthquakes minimizing damage, keeps away from dry rot termites, and provides additional security. Some buildings are built upon relatively high stilts thus can also be functional for stables of livestock while some other built upon relatively not-too-high as their places in the near shore soils.

*2. What is the building made of?*

*- Is it permanent or non-permanent (made of woods)?*

Most of Indonesian traditional buildings are made from woods, bamboos, etc. thus not permanent, while some other have used stones as materials of the buildings.

*3. How is the shape of the building from the bird-view?*

*- is it in a circling shape?*

*- is it a rectangle?*

*→ if yes, where is the door? Is it in the long side or in the short one?*

The shape of the buildings can be circles or ellipses while some other can also take the shape of the standard rectangle designs. However, the rectangle buildings can be differed by the location of its main door: some buildings place the door in the length side and some other in the short one.

*4. How is the decoration of the building? How is the building colored?*

This is an interesting part when we talk about the traditional buildings in Indonesia. The decoration is somewhat unique representing the availability of the colors used as the paint. In addition, some traditional buildings are also decorated with some engraved decoration. Balinese traditional buildings are considered one of the most richest with this kind of decoration but yet, use the natural colors of stones and rarely painted. In this discussion, we count the numbers of color used to decorate the buildings (excluded the natural color of the material) and for the sake of simplicity, we transform it into binary-digit, thus we still have the “1” and “0”.

*5. How is the spatial exploitation outside the building?*

*- is there any other construction established in the yard?*

*- is there any functional construction established in the yard?*

Some tradition-inspired buildings in Indonesia exploit the front-yard of the buildings. This front yard is usually used to build other building for food-storage, traditional religion-related artifacts (e.g.: statues), etc. The two questions above are shown in order to see whether the front yard is used for

---

<sup>1</sup> The numbers of province portrayed in the paper are as shown in the park namely 26. To day, the number has been growing for the emergence of new provincial administrations after the New Order Era (1999)..

several domestic related functional buildings, or just places for the religion-related architectural artifacts. An example of highly used front yard can be seen in Balinese buildings/palaces.

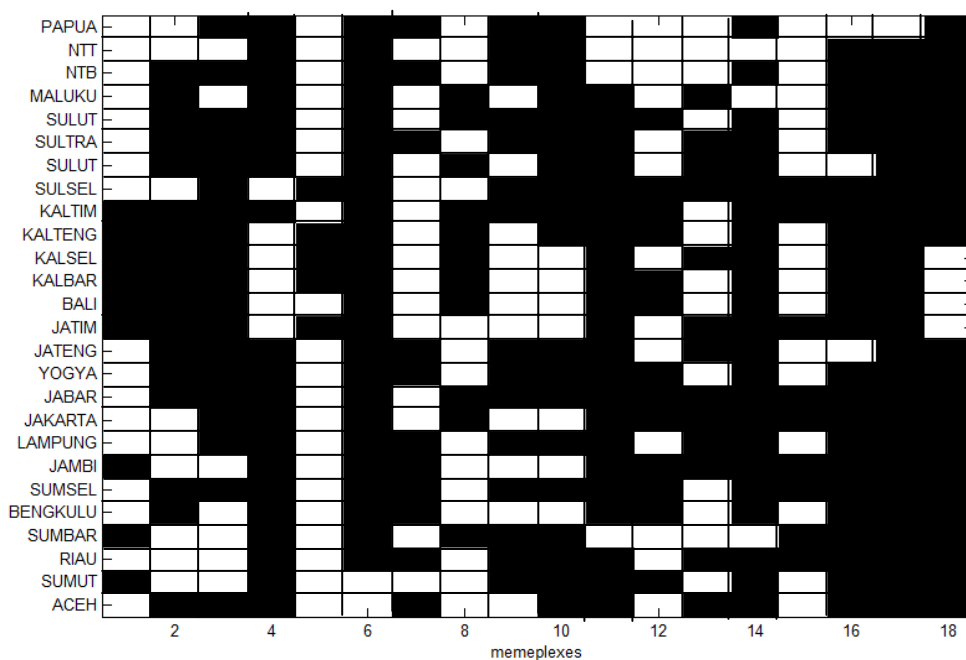
6. How is the general influence of other non-archipelagic cultures?  
 - Islam? Chinese? Hindu?

Most Indonesian cultures are geographically placed in coastal areas with high intensity of anchoring ships of merchants from all over the world. While the influence of Hindu is strong in most Indonesian ethnic customs, the colors of Chinese and Islamic influences are also recognized in the architecture of the traditional buildings.

If we denote each memeplex of artifact  $k$  is in binary,  $m_k^i \in \{0,1\}$ , then the memetic representation of artifact  $k$  can be written,

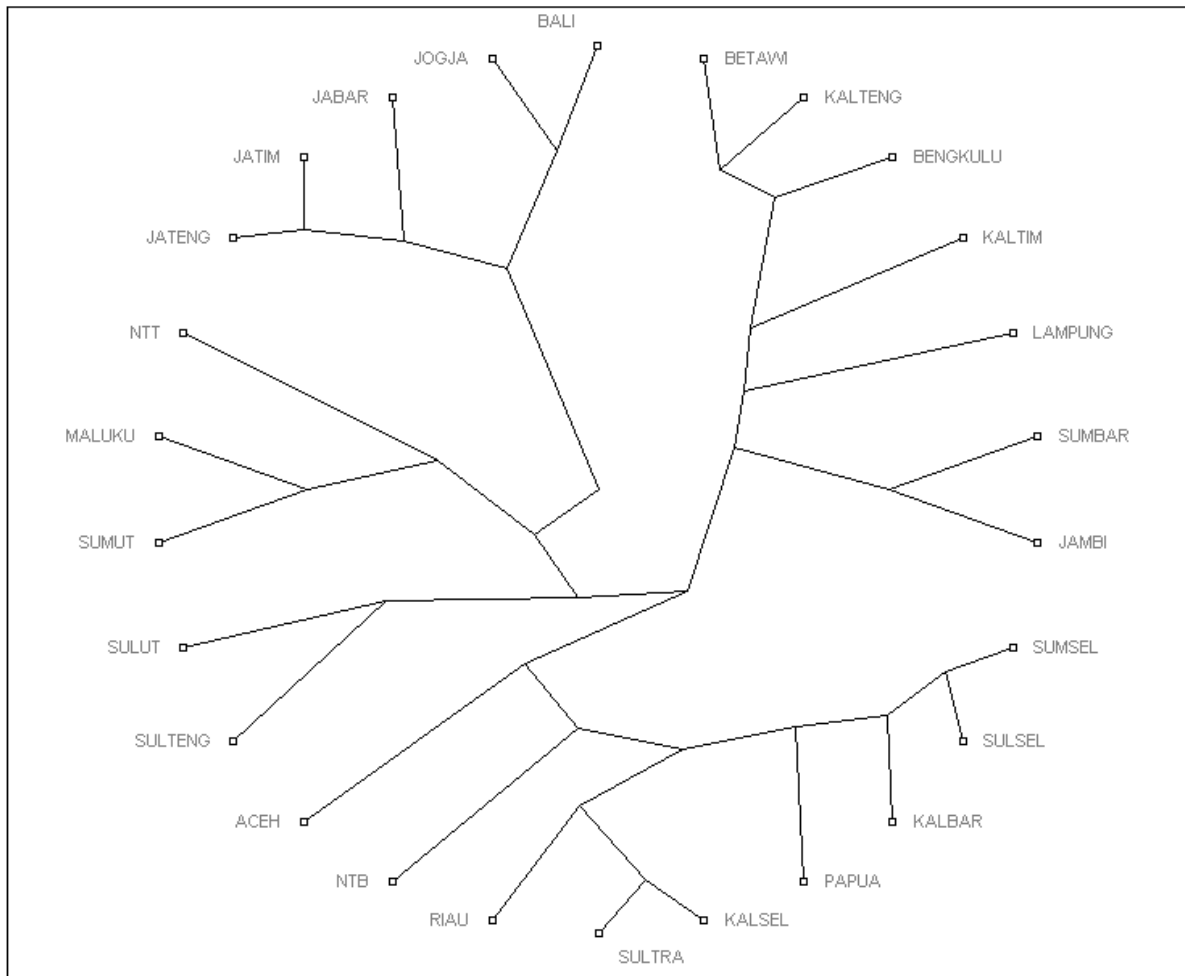
$$M_k = \bigcup_i^N m_i \tag{6}$$

where  $N$  is the total number of the elements of the memeplex. Figure 2 shows the memetic representation of the architectural designs in our case of study. As it has been discussed in Khanafiah & Situngkir (2006).



**Figure 2**  
 The Structure of Memeplex of Traditional Buildings in Nusantara

In our case, we use the Pearson's Product Moment Correlation between the elements of the memeplexes to measure how related an architectural designs of all traditional ethnic buildings as presented in the *Taman Mini Indonesia Indah* (TMII). Thus, the six classifiers we described above yield 19 binary memeplexes that we are going to use to visualize similarities and the “family tree” of the traditional buildings in Nusantara as shown in figure 2. It is apparent that there are strong correlations among the memeplexes as we would like to visualize in the phylomemetic diagram.



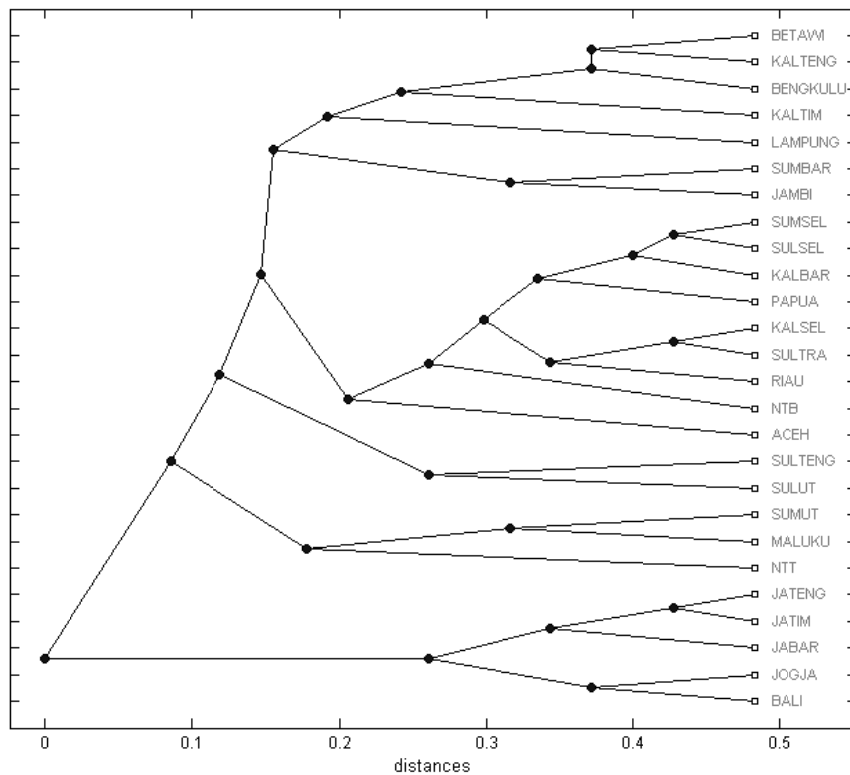
**Figure 3**  
The radial cladistics of phylomemetic tree of 26 area in Indonesia.

The phylomemetic diagram in radial form is shown in figure 3. In this figure the visualization emphasizes the bifurcation of the nodes and the clustering among artifacts. It is obvious that the buildings from the island of Java and Bali are clustered and clearly separated with other buildings. However, there is no very apparent strong bifurcations among building from other places. This has shown the diversity of buildings out of the island of Java spreading from Sumatera, Kalimantan, Sulawesi, Nusa Tenggara, to the Papua Island.

To have clearer view, we also draw the dendrogram form of the phylomemetic tree (figure 4). The axis of the figure shows the memetic distances between buildings. Interestingly, by only observing the six features, we could see the interesting similarities among the buildings. The closely related buildings with Jakarta, Central Kalimantan, Lampung, and Bengkulu while Southern Sumatra clustered with those from Southern Sulawesi. Some important insights are shown in the dendrogram more than just a visualization of the branching patterns, but also the quantitative “separation” of each cultural objects. For instance, the Aceh inspired buildings, even though it is not visualized branching directly from other Sumatera houses, it is in fact closely related to the clustering of Southern Sumatra and Southern Sulawesi.

From the evolutionary distances calculated based on six aspects we discussed before, it is apparent that there is open door for further analysis by using more detailed architectural features

incorporated in the memeplexes while the more data included in construction the phylomemetic tree based on different ethnicity whose different traditional house designs are also of future interest for further research.



**Figure 4**  
The phylomemetic tree with the Hamming-distances between buildings

#### 4. Closing Remarks

We have discussed things related to the phylomemetic trees related to the diverse nature of Indonesian culture. The traditional and cultural heritages can be seen its commonality while focusing on its differences one another. A thing that is important for preserving and realizing the value of the diversity in Indonesia. After revisiting some important highlights on constructing the diagrammatic view of the features in the artifacts we do some works for the phylomemetic tree of tradition-inspired buildings representing the provinces in Indonesia.

From the phylomemetic tree of the Indonesian houses, we can see some interesting features related to the nature of the houses in Indonesia. The highly clustered buildings in Java (West Java, Jogjakarta, Central Java, East Java, and Bali) seems to be closely related relative to those from other places. This was probably related to a lot of anthropological findings and hypotheses on the origin of Indonesian and Malay ancestors. The phylomemetic tree can be used to enrich those findings as well as the discussions about the chosen features to be put into account for the memeplexes.

Regarding to the works on architectural designs some enhancements are waiting to be conducted for further works while from the general discussion about the phylomemetic tree brought us for wide aspects with which we can utilize to explain a lot of issues on human culture evolution in general and the importance of its diversity. This is left as an interesting future development and research.



## **Acknowledgement**

Author thanks Rolan Mauludy for help in illustration and people in Indonesian Archipelago Culture Initiatives (IACI) for enjoyable accompanying in TMII.

## **References**

- Heylighen, F. (1993). "Selection Criteria for the Evolution of Knowledge". *Proceeding 13th International Congress on Cybernetics*. International Association of Cybernetics.
- Khanafiah, D. & Situngkir, H. (2006). *Innovation as Evolutionary Process*. Paper presented in Conference of Computation and Intelligence in Economics and Finance, Kaohsiung, October 8<sup>th</sup>-11<sup>th</sup> 2006.
- Khanafiah, D. & Situngkir, H. (2007). "Komposisi Siaran TV dan Stasiun TV". *BFI Working Paper Series WPW2007*.
- Kitching, I. J., Forey, P. L., Humphries, C. J., & Williams, D. M. (1998). *Cladistics: The Theory and Practice of Parsimony Analysis* 2nd edition. Oxford UP.
- Liberles, D. A. (2005). "Using Phylogeny to Understand Genomic Evolution". in Albert, V. A. (eds.). *Parsimony, Phylogeny, and Genomics*. Cambridge UP. pp. 181-9.
- Mantegna, R. M. & Stanley, H. E. (2000). *An Introduction to Econophysics, Correlations, and Complexity in Finance*. Cambridge UP.
- Situngkir, H. (2004). "On Selfish Meme: Culture as Complex Adaptive System". *Journal of Social Complexity* 2 (1): 20-32.