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Structural Modeling on PSiOS

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Abstract—*In this paper, an integrated system model is germinated for the structure of the privacy and security of iOS (PSiOS) devices with the help of the Matrix Algebra and Graph Theory. Firstly, the structure of the PSiOS is sculptural using Graph Theory, secondly using Variable Adjacency Matrix and last by a polynomial which is known as Permanent Function. In terms of Storage Optimization and execution time of a program, the Permanent Function provides a chance to effectuate the structural Analysis of PSiOS by comparing the properties of PSiOS with it. To germinate the Graph Model, Matrix Model and a polynomial permanent model, antithetic structural attributes of the PSiOS are identified. For the complete analysis of PSiOS system, top-down approach is also exemplified.*

1. INTRODUCTION

On the Security Side, we always have to remember that security for mobile devices is somewhat different than say desktops, you know that mobile devices that always on their move from network to network and more easily lost or stolen and that are typically loaded with a lot of personal and business data. Up-to-dateness mobile operating systems are following different approach to protest the user's personal information. Operating System of Apple devices are the most popular operating system after Android. IOS offers application Sandboxing [1] but specify a generic Sandboxing profile to every third-party application. However, recent attacks authorize applications to access contacts, photos and devices IDs. To lessen this problem, there is a tool know as PSiOS that features a novel policy enforcement [2] framework for iOS.

2. ARCHITECTURE OF PSIOS

The Architecture of PSiOS is delineated in Fig. 1.0. Our Design is trifid into distinct phases. (1) Static analysis [2] (offline), (2) Binary Rewriting [2] at load-time and (3) Runtime Control Flow Integrity and Policy Enforcement [2] at execution-time. Only Once Static Analysis phase is performed and whenever the Application is plunged by the user, the binary rewriting and runtime enforcement phases are performed. The wide spread workflow is as follows: To derive the application structure, firstly we revert engineer the application binary with the help of automated tool. For deriving the control flow application with the help of MOCFI [3], there is a requirement to obtain the execution path which are relevant (step 1) to utilize the static Objective–C [4] analyzer which regains the method of existing architecture like PiOS[4] and we analyze the existing classes and method of Objective-C with the help of Objective-C helper scripts [5] (step 2). For prolonging these tools we need to use all calls to system call wrapper. After application is plunged by user, firstly re-execute binary rewriting into the binary (step 3) to unite the control flow constraints. When the application access the Public Frameworks, System call wrapper and Objective-C runtime, checkpoints will be reached this is inserted by the Binary rewriting (step 4). During execution-time, with the help of Objective-C analyzer, we extract relevant information and confront the incompleteness of the static analysis (step 5). The control flow of the application, which follows the valid path, is secured by the Control-flow integrity (step 6). For accessing all the request of Policy enforcement, System call wrapper and Objective-C environment, when the accessing request follow the given policy rules (step 7).

2.1 Static Analyzer

By default, the iOS applications are in encrypted form. With the help of process dumping [6] technique, we can obtain the decrypted form of iOS Binary. After that with the help of MoCFI we design the CFG to resolve the target of indirect branches. Using PiOS we can resolve the Objective-C calls in innovative design of MoCFI. On experimental results shows that Objective-C structure is not always fetched by the PiOS when the static analysis is performed on it. Hence for identifying all important classes, inheritance relationship and methods within Objective-C structure, we proposed a novel static Objective-C analyzer.

2.2 Binary Rewriting and Runtime Enforcement

After the iOS application loader has insured the application signature, we use Binary Rewriting to prolong the application signature. For this PSiOS work on the rewriting-engine to check all the indirect branch instruction with the control flow. Moreover, PSiOS re-scripts all access requests to insert checkpoints at the Objective-C runtime. Whenever the execution of an application starts and the checkpoints has been reached, PSiOS ensures that valid CFG path has been followed by the call and gibe to the given sandboxing profile.

2.3 Enforcement Policies

There are three different types of Enforcement policies. Log, Exit and Replace. All the policy violation is recorded by System is ensured by the log option. This option helps system administrator for the identification of required Objective-C calls which are performed by application. Whenever the policy is violated, the current process is terminated instantly with the help of Exit Option. Replace option allows the application to run at execution time that replaces the values of Objective-C runtime by shadow data. If the Policy violation has occurred the sandboxing profile disallows the address book and returns the fake data or an empty data set.

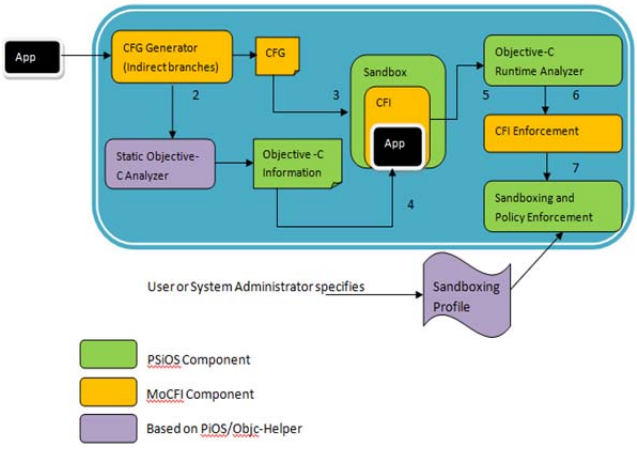

Fig. 1: Architecture of PSiOS

3. SYSTEM REPRESENTATION OF PSIOS

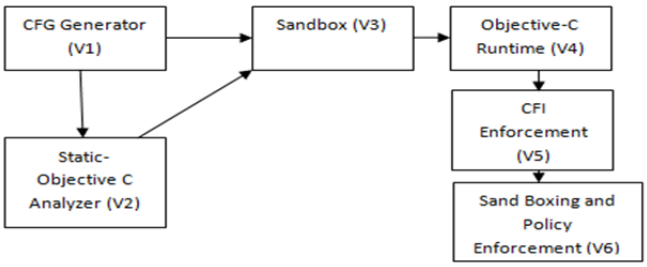

Fig. 2

A graph G is an ordered pair G=(V,E) where 'V' is a finite set of element and 'E' is a set of 2-subsets of 'V'. For representing a PSiOS system, we are assuming the appurtenance of this system denoted by means of the Vertex set {V} of the graph and interaction among different appurtenance is denoted by Edge set {E}. We converted Directed edges into Undirected Edges by means of directional properties that represent the interaction between the edges. There are six appurtenance (A1,A2,A3,A4,A5,A6) forming a PSiOS system shown Fig. 2 and these are shown by six vertices (V1,V2,V3,V4,V5,V6) i.e the appurtenance Ai is shown by the vertex Vi for germinating an algorithm. Connectivity between the appurtenance Ai and Aj is represented by the edge e_{ij}. If we assume that all the six appurtenance are interacting with each other, then the PSiOS system has a graph theoretic representation with $e_{ij}!=e_{ji}$. The $e_{ij}!=e_{ji}$ means that their influence are not equal to each other. In case of $e_{ij}=e_{ji}$, while direction is not substantial, then we use undirected graph of PSiOS system for the representation.

4. DIRECTED AND UNDIRECTED GRAPH REPRESENTATION OF PSIOS

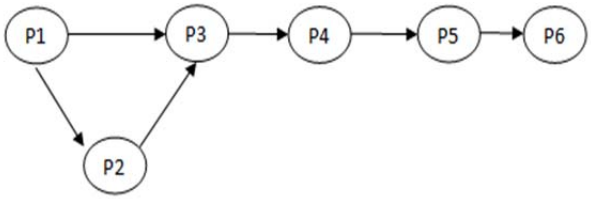

Fig. 3: Directed Graph of PSiOS

Assuming that if we don't include the directional interaction i.e $p_{ij}=p_{ji}$, then the PSiOS system is represented by an undirected graph shown in Fig. 3 and 4.

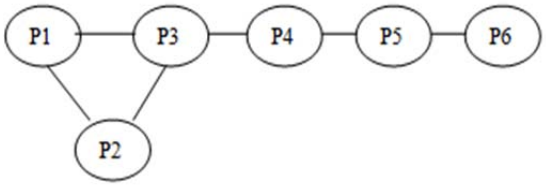

Fig. 4: Undirected Graph of PSiOS

5. MATRIX REPRESENTATION OF PSIOS

Let us consider a matrix $A=[p_{ij}]$ where rows and columns are represented by the vertices or nodes of diagraph i.e the p_{ij} represents the connectivity of one vertices to another vertices.

P_{ij} ={ 1, if one vertex is connected to another vertex

0, otherwise}

Equation 1

The PSiOS system matrix representing the diagraph shown in fig 5 is written as:

$$A=\begin{pmatrix} 0 & 1 & 1 & 0 & 0 \\ 0 & & & & \\ 1 & 0 & 1 & 0 & 0 \\ 0 & & & & \\ 1 & 1 & 0 & 1 & 0 \\ 0 & & & & \end{pmatrix}$$

In the above matrix A, the value of p_{ij} i.e p14, p15, p16, p24, p25, p26, p35, p36, p41, p42, p46, p51, p52, p53, p61, p62, p63, p64 are zero because there is no connectivity with each other and there is no dependency or interaction of the vertices itself therefore the diagonal element are zero. A characteristic matrix is defined, to characterize the PSiOS system.

6. CHARACTERISTICS MATRIX REPRESENTATION OF PSIOS

Equation 2

Let we consider the identity matrix 'I' and 'P' as the variable representing the PSiOS system.

$$\text{Identity matrix, } I=\begin{pmatrix} 1&0&0&0&0&0\\ 0&1&0&0&0&0\\ 0&0&1&0&0&0\\ 0&0&0&1&0&0\\ 0&0&0&0&1&0\\ 0&0&0&0&0&1 \end{pmatrix}$$

The characteristics matrix B of the PSiOS system from the diagraph represent in fig 5, may be expressed as [(P *I)-A] where 'A' is represented in Equation 1.

PSiOS characteristics matrix, B=[(P*I)-A]

$$B=P*\begin{pmatrix} 1&0&0&0&0&0\\ 0&1&0&0&0&0\\ 0&0&1&0&0&0\\ 0&0&0&1&0&0\\ 0&0&0&0&1&0\\ 0&0&0&0&0&1 \end{pmatrix}\quad\begin{pmatrix} 0&1&1&0&0&0\\ 1&0&1&0&0&0\\ 1&1&0&1&0&0\\ 0&0&1&0&1&0\\ 0&0&0&1&0&1\\ 0&0&0&0&1&0 \end{pmatrix}$$

$$B=\begin{pmatrix} P&0&0&0&0&0\\ 0&P&0&0&0&0\\ 0&0&P&0&0&0\\ 0&0&0&P&0&0\\ 0&0&0&0&P&0\\ 0&0&0&0&0&P \end{pmatrix}\quad\begin{pmatrix} 0&1&1&0&0&0\\ 1&0&1&0&0&0\\ 1&1&0&1&0&0\\ 0&0&1&0&1&0\\ 0&0&0&1&0&1\\ 0&0&0&0&1&0 \end{pmatrix}$$

$$B=\begin{pmatrix} P&-1&-1&0&0&0\\ -1&P&-1&0&0&0\\ -1&-1&P&-1&0&0\\ 0&0&-1&P&-1&0\\ 0&0&0&-1&P&1\\ 0&0&0&0&-1&P \end{pmatrix}$$

In above matrix B, all the diagonal elements values are same. The connectivity/interaction between the vertices/nodes have been assigned values of 0 and 1 depending on whether they are connected or not but it is not representing the varying degree of influence of one vertices/node over another vertices/node. To reckon this, PSiOS variable characteristics matrix is evaluated.

7. VARIABLE CHARACTERISTICS MATRIX REPRESENTATION OF PSIOS

Equation 3

Let we consider a diagraph in fig 5 for defining variable characteristics matrix of PSiOS system. Consider a square matrix C with off diagonal element from matrix A (Equation 1).

$$C=\begin{pmatrix} 0&p12&p13&0&0&0\\ P21&0&p23&0&0&0\\ P31&p32&0&p34&0&0\\ 0&0&p43&0&p45&0\\ 0&0&0&p54&0&p56\\ 0&0&0&0&p65&0 \end{pmatrix}$$

P_{ij} represents the connectivity between the vertices/nodes of the diagraph. Assuming another matrix 'D' with only the diagonal element Pi where i=1, 2, 3, 4, 5, 6 representing the different subsystems.

$$D=\begin{pmatrix} P1&0&0&0&0&0\\ 0&P2&0&0&0&0\\ 0&0&P3&0&0&0\\ 0&0&0&P4&0&0\\ 0&0&0&0&P5&0\\ 0&0&0&0&0&P6 \end{pmatrix}$$

Considering Matrices 'C' and 'D', variable characteristics matrix of PSiOS system is expressed as H=[D-C].

$$H=\begin{pmatrix} P1&-P12&-P13&0&0&0\\ -P21&P2&-P23&0&0&0\\ -P31&-P32&P3&-P34&0&0\\ 0&0&-P43&P4&-P45&0\\ 0&0&0&-P54&P5&-p56\\ 0&0&0&0&-P65&P6 \end{pmatrix}$$

The complete information about all the six subsystem is authorized by the above matrix 'H'. For design, analysis and development, this data is efficacious for new PSiOS products for the purpose of optimization at different stages. The variable characteristics PSiOS polynomial is a matrix glut a regent tool through its determinant. It exemplifies the complete PSiOS system that shows the characteristics of the

system by considering the interaction and effect of PSiOS subsystem.

The determinant of the matrix 'H', contains the negative and positive terms. The polynomial contains all the information of PSiOS system. Information will be lost, if we replace this terms with their mathematical values. Due to the additional and subtraction of mathematical values, the full information of the PSiOS system will get or will be lost by means of diagonal and off-diagonal elements. Thus, the matrix H, fails to provide the complete information under some certain condition. To avert the forfeit of structural information during the numerical process, another matrix is generated known as Variable Permanent Matrix.

8. VARIABLE PERMANENT MATRIX REPRESENTATION OF PSIOS

Equation 4

Variable Permanent Matrix of PSiOS system is generated to avert the forfeit of structural information during the numerical process which is introduced from the Fig. 2 and Fig. 4. It is defined as

$$E=\begin{pmatrix} P1 & P12 & P13 & 0 & 0 & 0 \\ P21 & P2 & P23 & 0 & 0 & 0 \\ P31 & P32 & P3 & P34 & 0 & 0 \\ 0 & 0 & P43 & P4 & P45 & 0 \\ 0 & 0 & 0 & P54 & P5 & p56 \\ 0 & 0 & 0 & 0 & P65 & P6 \end{pmatrix}$$

In above Matrix E, the diagonal element exemplifies the six critical subsystems and the interaction between the subsystems is represented by the off-diagonal element.

9. PERMANENT FUNCTION PRESENTATION

Both the matrix and diagraph representation are usual as these models can be changed by changing the name of nodes. To germinate a unique representation of PSiOS system, independent of labeling a Permanent Function of the matrix is created. The Permanent Function is incurred from a matrix in the same process as we calculate the determinants. A negative sign emerges in the expansion of determinant while in the Variable Permanent Function, positive sign is altered with the negative signs. These mathematical process results in a multinomial (Equation 6), which has a physical significance of each and every terms of PSiOS system.

The Variable Permanent Function for PSiOS system is (Equation 5)

$$Per(p)=((((P_6*P_5-P_{65}*P_{56})*P_4+((-P_6*P_{54}+P_{64}*P_{56})*P_{45}+(P_{65}*P_{54}-P_{64}*P_5)*P_{46}))*P_3+(((-P_6*P_5+P_{65}*P_{56})*P_{43}+((P_6*P_{53}-P_{63}*P_{56})*P_{45}+(-P_{65}*P_{53}+P_{63}*P_5)*P_{46}))*P_{34}+(((P_6*P_{54}-P_{64}*P_{56})*P_{43}+((P_6*P_{53}+P_{63}*P_{56})*P_4+(P_{64}*P_{53}-P_{63}*P_{54})*P_{46}))*P_{35}+((P_{65}*P_{54}+P_{64}*P_5)*P_{43}+((P_{65}*P_{53}-P_{63}*P_5)*P_4+(-P_{64}*P_{53}+P_{63}*P_{54})*P_{45}))*P_{36})))*P_2+((((-P_6*P_5+P_{65}*P_{56})*P_4+((P_6*P_{54}-P_{64}*P_{56})*P_{45}+(-P_{65}*P_{54}+P_{64}*P_5)*P_{46}))*P_{32}+(((P_6*P_5-P_{65}*P_{56})*P_{42}+((-P_6*P_{52}+P_{62}*P_{56})*P_{45}+(P_{65}*P_{52}-P_{62}*P_5)*P_{46}))*P_{34}+(((-P_6*P_{54}+P_{64}*P_{56})*P_{42}+((P_6*P_{52}-P_{62}*P_{56})*P_4+(-P_{64}*P_{52}+P_{62}*P_{54})*P_{46}))*P_{35}+((P_{65}*P_{54}-P_{64}*P_5)*P_{42}+((-P_{65}*P_{52}+P_{62}*P_5)*P_4+(P_{64}*P_{52}-P_{62}*P_{54})*P_{45}))*P_{36})))*P_{23}+((((P_6*P_5-P_{65}*P_{56})*P_{43}+((-P_6*P_{53}+P_{63}*P_{56})*P_{45}+(P_{65}*P_{53}-P_{63}*P_5)*P_{46}))*P_{32}+((-P_6*P_5+P_{65}*P_{56})*P_{42}+((P_6*P_{52}-P_{62}*P_{56})*P_{45}+(-P_{65}*P_{52}+P_{62}*P_5)*P_{46}))*P_3+((P_6*P_{53}-P_{63}*P_{56})*P_{42}+((-P_6*P_{52}+P_{62}*P_{56})*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_{46}))*P_{35}+((-P_{65}*P_{53}+P_{63}*P_5)*P_{42}+((P_{65}*P_{52}-P_{62}*P_5)*P_{43}+(P_{63}*P_{52}+P_{62}*P_{53})*P_{45}))*P_{36}))*P_{24}+((((-P_6*P_{54}+P_{64}*P_{56})*P_{43}+((P_6*P_{53}-P_{63}*P_{56})*P_4+(-P_{64}*P_{53}+P_{63}*P_{54})*P_{46}))*P_{32}+(((P_6*P_{54}-P_{64}*P_{56})*P_{42}+((-P_6*P_{52}+P_{62}*P_{56})*P_4+(P_{64}*P_{52}-P_{62}*P_{54})*P_{46}))*P_3+(((-P_6*P_{53}+P_{63}*P_{56})*P_{42}+((P_6*P_{52}-P_{62}*P_{56})*P_{43}+(-P_{63}*P_{52}+P_{62}*P_{53})*P_{46}))*P_{34}+((P_{64}*P_{53}-P_{63}*P_{54})*P_{42}+((-P_{64}*P_{52}+P_{62}*P_{54})*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_4))*P_{36})))*P_{25}+(((P_{65}*P_{54}-P_{64}*P_5)*P_{43}+((-P_{65}*P_{53}+P_{63}*P_5)*P_4+(P_{64}*P_{53}-P_{63}*P_{54})*P_{45}))*P_{32}+(((-P_{65}*P_{54}+P_{64}*P_5)*P_{42}+((P_{65}*P_{52}-P_{62}*P_5)*P_4+(-P_{64}*P_{52}+P_{62}*P_{54})*P_{45}))*P_3+(((P_{65}*P_{53}-P_{63}*P_5)*P_{42}+((-P_{65}*P_{52}+P_{62}*P_5)*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_{45}))*P_{34}+((-P_{64}*P_{53}+P_{63}*P_{54})*P_{42}+((P_{64}*P_{52}-P_{62}*P_{54})*P_{43}+(-P_{63}*P_{52}+P_{62}*P_{53})*P_4))*P_{35})))*P_{26})))*P_1+((((-P_6*P_5+P_{65}*P_{56})*P_4+((P_6*P_{54}-P_{64}*P_{56})*P_{45}+(-P_{65}*P_{54}+P_{64}*P_5)*P_{46}))*P_3+(((P_6*P_5-P_{65}*P_{56})*P_{43}+((-P_6*P_{53}+P_{63}*P_{56})*P_{45}+(P_{65}*P_{53}-P_{63}*P_5)*P_{46}))*P_{34}+(((-P_6*P_{54}+P_{64}*P_{56})*P_{43}+((P_6*P_{53}-P_{63}*P_{56})*P_4+(-P_{64}*P_{53}+P_{63}*P_{54})*P_{46}))*P_{35}+((P_{65}*P_{54}-P_{64}*P_5)*P_{43}+((-P_{65}*P_{53}+P_{63}*P_5)*P_4+(P_{64}*P_{53}-P_{63}*P_{54})*P_{45}))*P_{36})))*P_{21}+((((P_6*P_5-P_{65}*P_{56})*P_4+((-P_6*P_{54}+P_{64}*P_{56})*P_{45}+(P_{65}*P_{54}-P_{64}*P_5)*P_{46}))*P_{31}+(((-P_6*P_5+P_{65}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{45}+(-P_{65}*P_{51}+P_{61}*P_5)*P_{46}))*P_{34}+(((P_6*P_{54}-P_{64}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_4+(P_{64}*P_{51}-P_{61}*P_{54})*P_{46}))*P_{35}+((-P_{65}*P_{54}+P_{64}*P_5)*P_{41}+((P_{65}*P_{51}-P_{61}*P_5)*P_4+(-P_{64}*P_{51}+P_{61}*P_{54})*P_{45}))*P_{36})))*P_{23}+((((-P_6*P_5+P_{65}*P_{56})*P_{43}+((P_6*P_{53}-P_{63}*P_{56})*P_{45}+(-P_{65}*P_{53}+P_{63}*P_5)*P_{46}))*P_{31}+$$

$$(((P_6*P_5-P_{65}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{45}+(P_{65}*P_{51}-P_{61}*P_5)*P_{46}))*P_3+(((-P_6*P_{53}+P_{63}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{43}+(-P_{63}*P_{51}+P_{61}*P_{53})*P_{46}))*P_{35}+((P_{65}*P_{53}-P_{63}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_{45}))*P_{36}))*P_{24}+((((P_6*P_{54}-P_{64}*P_{56})*P_{43}+((-P_6*P_{53}+P_{63}*P_{56})*P_4+(P_{64}*P_{53}-P_{63}*P_{54})*P_{46}))*P_{31}+(((-P_6*P_{54}+P_{64}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_4+(-P_{64}*P_{51}+P_{61}*P_{54})*P_{46}))*P_3+(((P_6*P_{53}-P_{63}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_{46}))*P_{34}+((-P_{64}*P_{53}+P_{63}*P_{54})*P_{41}+((P_{64}*P_{51}-P_{61}*P_{54})*P_{43}+(-P_{63}*P_{51}+P_{61}*P_{53})*P_4))*P_{36}))*P_{25}+(((-P_{65}*P_{54}+P_{64}*P_5)*P_{43}+((P_{65}*P_{53}-P_{63}*P_5)*P_4+(-P_{64}*P_{53}+P_{63}*P_{54})*P_{45}))*P_{31}+(((P_{65}*P_{54}-P_{64}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_4+(P_{64}*P_{51}-P_{61}*P_{54})*P_{45}))*P_3+(((-P_{65}*P_{53}+P_{63}*P_5)*P_{41}+((P_{65}*P_{51}-P_{61}*P_5)*P_{43}+(-P_{63}*P_{51}+P_{61}*P_{53})*P_{45}))*P_{34}+((P_{64}*P_{53}-P_{63}*P_{54})*P_{41}+((-P_{64}*P_{51}+P_{61}*P_{54})*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_4))*P_{35}))*P_{26}))))*P_{12}+((((P_6*P_5-P_{65}*P_{56})*P_4+((-P_6*P_{54}+P_{64}*P_{56})*P_{45}+(P_{65}*P_{54}-P_{64}*P_5)*P_{46}))*P_{32}+(((-P_6*P_5+P_{65}*P_{56})*P_{42}+((P_6*P_{52}-P_{62}*P_{56})*P_{45}+(-P_{65}*P_{52}+P_{62}*P_5)*P_{46}))*P_{34}+(((P_6*P_{54}-P_{64}*P_{56})*P_{42}+((-P_6*P_{52}+P_{62}*P_{56})*P_4+(P_{64}*P_{52}-P_{62}*P_{54})*P_{46}))*P_{35}+((-P_{65}*P_{54}+P_{64}*P_5)*P_{42}+((P_{65}*P_{52}-P_{62}*P_5)*P_4+(-P_{64}*P_{52}+P_{62}*P_{54})*P_{45}))*P_{36}))*P_{21}+((((-P_6*P_5+P_{65}*P_{56})*P_4+((P_6*P_{54}-P_{64}*P_{56})*P_{45}+(-P_{65}*P_{54}+P_{64}*P_5)*P_{46}))*P_{31}+(((P_6*P_5-P_{65}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{45}+(P_{65}*P_{51}-P_{61}*P_5)*P_{46}))*P_{32}+(((-P_6*P_{52}+P_{62}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_{46}))*P_{35}+((P_{65}*P_{52}-P_{62}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{45}))*P_{36}))*P_{23}+((((P_6*P_{53}-P_{63}*P_{56})*P_{42}+((-P_6*P_{52}+P_{62}*P_{56})*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_{46}))*P_{31}+(((-P_6*P_{53}+P_{63}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{43}+(P_{63}*P_{51}+P_{61}*P_{53})*P_{46}))*P_{32}+(((P_6*P_{52}-P_{62}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{46}))*P_3+((-P_{63}*P_{52}+P_{62}*P_{53})*P_{41}+((P_{63}*P_{51}-P_{61}*P_{53})*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_{43}))*P_{36}))*P_{25}+(((-P_{65}*P_{53}+P_{63}*P_5)*P_{42}+((P_{65}*P_{52}-P_{62}*P_5)*P_{43}+(-P_{63}*P_{52}+P_{62}*P_{53})*P_{45}))*P_{31}+(((P_{65}*P_{53}-P_{63}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_{45}))*P_{32}+(((-P_{65}*P_{52}+P_{62}*P_5)*P_{41}+((P_{65}*P_{51}-P_{61}*P_5)*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_{45}))*P_3+((P_{63}*P_{52}-P_{62}*P_{53})*P_{41}+((-P_{63}*P_{51}+P_{61}*P_{53})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{43}))*P_{35}))*P_{26}))))*P_{13}+((((-P_6*P_5+P_{65}*P_{56})*P_{43}+((P_6*P_{53}-P_{63}*P_{56})*P_{45}+(-P_{65}*P_{53}+P_{63}*P_5)*P_{46}))*P_{32}+(((P_6*P_5-P_{65}*P_{56})*P_{42}+((-P_6*P_{52}+P_{62}*P_{56})*P_{45}+(P_{65}*P_{52}-P_{62}*P_5)*P_{46}))*P_3+(((-P_6*P_{53}+P_{63}*P_{56})*P_{42}+((P_6*P_{52}-P_{62}*P_{56})*P_{43}+(P_{63}*P_{52}+P_{62}*P_{53})*P_{46}))*P_{35}+((P_{65}*P_{53}-P_{63}*P_5)*P_{42}+((-P_{65}*P_{52}+P_{62}*P_5)*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_{45}))*P_{36}))*P_{21}+((((P_6*P_5-P_{65}*P_{56})*P_{43}+((-P_6*P_{53}+P_{63}*P_{56})*P_{45}+(P_{65}*P_{53}-P_{63}*P_5)*P_{46}))*P_{31}+(((-P_6*P_5+P_{65}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{45}+(-P_{65}*P_{51}+P_{61}*P_5)*P_{46}))*P_3+(((P_6*P_{53}-P_{63}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_{46}))*P_{35}+((-P_{65}*P_{53}+P_{63}*P_5)*P_{41}+((P_{65}*P_{51}-P_{61}*P_5)*P_{43}+(-P_{63}*P_{51}+P_{61}*P_{53})*P_{45}))*P_{36}))*P_2+((((-P_6*P_5+P_{65}*P_{56})*P_{42}+((P_6*P_{52}-P_{62}*P_{56})*P_{45}+(-P_{65}*P_{52}+P_{62}*P_5)*P_{46}))*P_{31}+(((P_6*P_5-P_{65}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{45}+(P_{65}*P_{51}-P_{61}*P_5)*P_{46}))*P_{32}+(((-P_6*P_{52}+P_{62}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_{46}))*P_{35}+((P_{65}*P_{52}-P_{62}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{45}))*P_{36}))*P_{23}+((((P_6*P_{53}-P_{63}*P_{56})*P_{42}+((-P_6*P_{52}+P_{62}*P_{56})*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_{46}))*P_{31}+(((-P_6*P_{53}+P_{63}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{43}+(P_{63}*P_{51}+P_{61}*P_{53})*P_{46}))*P_{32}+(((P_6*P_{52}-P_{62}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{46}))*P_3+((-P_{63}*P_{52}+P_{62}*P_{53})*P_{41}+((P_{63}*P_{51}-P_{61}*P_{53})*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_{43}))*P_{36}))*P_{25}+(((-P_{65}*P_{53}+P_{63}*P_5)*P_{42}+((P_{65}*P_{52}-P_{62}*P_5)*P_{43}+(-P_{63}*P_{52}+P_{62}*P_{53})*P_{45}))*P_{31}+(((P_{65}*P_{53}-P_{63}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_{45}))*P_{32}+(((-P_{65}*P_{52}+P_{62}*P_5)*P_{41}+((P_{65}*P_{51}-P_{61}*P_5)*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_{45}))*P_3+((P_{63}*P_{52}-P_{62}*P_{53})*P_{41}+((-P_{63}*P_{51}+P_{61}*P_{53})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{43}))*P_{35}))*P_{26}))))*P_{14}+((((P_6*P_{54}-P_{64}*P_{56})*P_{43}+((-P_6*P_{53}+P_{63}*P_{56})*P_4+(P_{64}*P_{53}-P_{63}*P_{54})*P_{46}))*P_{32}+(((-P_6*P_{54}+P_{64}*P_{56})*P_{42}+((P_6*P_{52}-P_{62}*P_{56})*P_4+(-P_{64}*P_{52}+P_{62}*P_{54})*P_{46}))*P_3+(((P_6*P_{53}-P_{63}*P_{56})*P_{42}+((P_6*P_{52}+P_{62}*P_{56})*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_{46}))*P_{34}+((-P_{64}*P_{53}+P_{63}*P_{54})*P_{42}+((P_{64}*P_{52}-P_{62}*P_{54})*P_{43}+(-P_{63}*P_{52}+P_{62}*P_{53})*P_4))*P_{36}))*P_{21}+((((-P_6*P_{54}+P_{64}*P_{56})*P_{43}+((P_6*P_{53}-P_{63}*P_{56})*P_4+(-P_{64}*P_{53}+P_{63}*P_{54})*P_{46}))*P_{31}+(((P_6*P_{54}-P_{64}*P_{56})*P_{41}+((P_6*$$

$P_{51}+P_{61}*P_{56})*P_4+(P_{64}*P_{51}-P_{61}*P_{54})*P_{46}))*P_3+(((-P_6*P_{53}+P_{63}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{43}+(-P_{63}*P_{51}+P_{61}*P_{53})*P_{46}))*P_{34}+((P_{64}*P_{53}-P_{63}*P_{54})*P_{41}+((-P_{64}*P_{51}+P_{61}*P_{54})*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_4))*P_{36})))*P_2+((((P_6*P_{54}-P_{64}*P_{56})*P_{42}+((-P_6*P_{52}+P_{62}*P_{56})*P_4+(P_{64}*P_{52}-P_{62}*P_{54})*P_{46}))*P_{31}+(((-P_6*P_{54}+P_{64}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_4+(-P_{64}*P_{51}+P_{61}*P_{54})*P_{46}))*P_{32}+(((P_6*P_{52}-P_{62}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{46}))*P_{34}+((-P_{64}*P_{52}+P_{62}*P_{54})*P_{41}+((P_{64}*P_{51}-P_{61}*P_{54})*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_4))*P_{36})))*P_{23}+((((-P_6*P_{53}+P_{63}*P_{56})*P_{42}+((P_6*P_{52}-P_{62}*P_{56})*P_{43}+(-P_{63}*P_{52}+P_{62}*P_{53})*P_{46}))*P_{31}+(((P_6*P_{53}P_{63}*P_{56})*P_{41}+((-P_6*P_{51}+P_{61}*P_{56})*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_{46}))*P_{32}+(((-P_6*P_{52}+P_{62}*P_{56})*P_{41}+((P_6*P_{51}-P_{61}*P_{56})*P_{42}+(P_{62}*P_{51}+P_{61}*P_{52})*P_{46}))*P_3+((P_{63}*P_{52}-P_{62}*P_{53})*P_{41}+((-P_{63}*P_{51}+P_{61}*P_{53})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{43}))*P_{36})))*P_{24}+(((P_{64}*P_{53}-P_{63}*P_{54})*P_{42}+((-P_{64}*P_{52}+P_{62}*P_{54})*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_4))*P_{31}+(((-P_{64}*P_{53}+P_{63}*P_{54})*P_{41}+((P_{64}*P_{51}-P_{61}*P_{54})*P_{43}+(-P_{63}*P_{51}+P_{61}*P_{53})*P_4))*P_{32}+(((P_{64}*P_{52}-P_{62}*P_{54})*P_{41}+((-P_{64}*P_{51}+P_{61}*P_{54})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_4))*P_3+((-P_{63}*P_{52}+P_{62}*P_{53})*P_{41}+((P_{63}*P_{51}-P_{61}*P_{53})*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_{43}))*P_{34})))*P_{26})))*P_{15}+((((-P_{65}*P_{54}+P_{64}*P_5)*P_{43}+((P_{65}*P_{53}-P_{63}*P_5)*P_4+(-P_{64}*P_{53}+P_{63}*P_{54})*P_{45}))*P_{32}+(((P_{65}*P_{54}-P_{64}*P_5)*P_{42}+((-P_{65}*P_{52}+P_{62}*P_5)*P_4+(P_{64}*P_{52}-P_{62}*P_{54})*P_{45}))*P_3+(((-P_{65}*P_{53}+P_{63}*P_5)*P_{42}+((P_{65}*P_{52}-P_{62}*P_5)*P_{43}+(-P_{63}*P_{52}+P_{62}*P_{53})*P_{45}))*P_{34}+((P_{64}*P_{53}-P_{63}*P_{54})*P_{42}+((-P_{64}*P_{52}+P_{62}*P_{54})*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_4))*P_{35})))*P_{21}+((((P_{65}*P_{54}-P_{64}*P_5)*P_{43}+((-P_{65}*P_{53}+P_{63}*P_5)*P_4+(P_{64}*P_{53}-P_{63}*P_{54})*P_{45}))*P_{31}+(((-P_{65}*P_{54}+P_{64}*P_5)*P_{41}+((P_{65}*P_{51}-P_{61}*P_5)*P_4+(P_{64}*P_{51}+P_{61}*P_{54})*P_{45}))*P_3+(((P_{65}*P_{53}-P_{63}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_{43}+(P_{63}*P_{51}-P_{61}*P_{53})*P_{45}))*P_{34}+((-P_{64}*P_{53}+P_{63}*P_{54})*P_{41}+((P_{64}*P_{51}-P_{61}*P_{54})*P_{43}+(-P_{63}*P_{51}+P_{61}*P_{53})*P_4))*P_{35})))*P_2+((((-P_{65}*P_{54}+P_{64}*P_5)*P_{42}+((P_{65}*P_{52}-P_{62}*P_5)*P_4+(-P_{64}*P_{52}+P_{62}*P_{54})*P_{45}))*P_{31}+(((P_{65}*P_{54}-P_{64}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_4+(P_{64}*P_{51}-P_{61}*P_{54})*P_{45}))*P_{32}+(((-P_{65}*P_{52}+P_{62}*P_5)*P_{41}+((P_{65}*P_{51}-P_{61}*P_5)*P_{42}+(-P_{62}*P_{51}+P_{61}*P_{52})*P_{45}))*P_{34}+((P_{64}*P_{52}-P_{62}*P_{54})*P_{41}+((-P_{64}*P_{51}+P_{61}*P_{54})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_4))*P_{35})))*P_{23}+((((P_{65}*P_{53}-P_{63}*P_5)*P_{42}+((-P_{65}*P_{52}+P_{62}*P_5)*P_{43}+(P_{63}*P_{52}-P_{62}*P_{53})*P_{45}))*P_{31}+(((-P_{65}*P_{53}+P_{63}*P_5)*P_{41}+((P_{65}*P_{51}-P_{61}*P_5)*P_{43}+(-P_{63}*P_{51}+P_{61}*P_{53})*P_{45}))*P_{32}+(((P_{65}*P_{52}-P_{62}*P_5)*P_{41}+((-P_{65}*P_{51}+P_{61}*P_5)*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{45}))*P_3+((P_{63}*P_{52}-P_{62}*P_{53})*P_{41}+((-P_{63}*P_{51}+P_{61}*P_{53})*P_{42}+(P_{62}*P_{51}-P_{61}*P_{52})*P_{43}))*P_{34})))*P_{25})))*P_{16}$

The equation above is germinated for six subsystem of the PSiOS system which contain 720 terms. But it is reduced to minimum terms because the variables P_{35}, P_{36} ,P_{41} ,P_{42} ,P_{46} ,P_{51} ,P_{52} .P_{53} ,P_{61} ,P_{62} ,P_{63} ,P_{64} ,P_{14} ,P_{15} ,P_{16} ,P_{24} ,P_{25} and P_{26} are 0 which means that there is no connectivity or the interaction are missing.

The Variable Permanent Function for PSiOS system is (Equation 6) $Per(E) = (P_1P_2P_3P_4P_5P_6)-P_1P_2P_3P_4P^2_{56}-P_1P_2P_3P^2_{45}P_6+P_1P_2P^2_{34}P^2_{56}-P_1P_2P^2_{34}P_5P_6+P_1P^2_{23}P_4P^2_{56}-P_1P^2_{23}P_4P_5P_6-P_1P^2_{23}P^2_{45}P_6+P^2_{12}P_3P_4 \quad P^2_{56}-P^2_{12}P_3P_4P_5P_6+P^2_{12}P_3P^2_{54}P_6+P^2_{12}P^2_{34}P_5P_6-P^2_{12}P^2_{34}P^2_{56}+P_{12}P_{23}P_{31}P_4P_5P_6-P_{12}P_{23}P_{31}P_4P^2_{56}-P_{12}P_{23}P_{31}P^2_{45}P_6+P_{13}P_{21}P_{32}P_4P_5P_6-P_{13}P_{21}P_{34}P_4P^2_{56}-P_{13}P_{21}P_{32}P^2_{54}P_6+P^2_{13}P_2P^2_{45}P_6$

The above equation is unambiguously representing the PSiOS system. The Permanent Function of Equation (6) is written in a standard form as (N+1) groups. At the different level, the polynomial presents as thorough way of analysis of a PSiOS material. Among the various subsystems of the PSiOS, it helps in determining different appurtenance, process parameter and design attributes.

Group 1:- It contain only 1 term of six vertices i.e six subsystems are independent constituents.

Group 2:- Subsystem has no connectivity with itself therefore this group is empty.

Group 3:- Include 5 terms; each term has a set of two subsystem loop i.e P_{ij}, P_{ji} and the three independent subsystems.

Group 4:- Include 2 terms; each term has a set of three-subsystem loop and three independent subsystems.

Group 5:- Include 7 terms; each term is a subset of two subsystem loops and two independent subsystems.

Group 6 has two subgroups:- Group 6(i) include 3 terms, each terms has a set of three-subsystem loop, two subsystem loop and one independent subsets while Group 6(ii) include only one term i.e two-subsystem loop, connectivity of three subsystem and one independent subsystem.

Group 7:-Include only one term i.e three subsystem loop and zero independent subsystems.

Generally, Permanent Function of Six subsystem will have !6 i.e 720 terms arranged in (N+1) group. Fig. 6 gives the graphical representation for Equation 6 for improvement, analysis and Visual understanding of a PSiSO system.

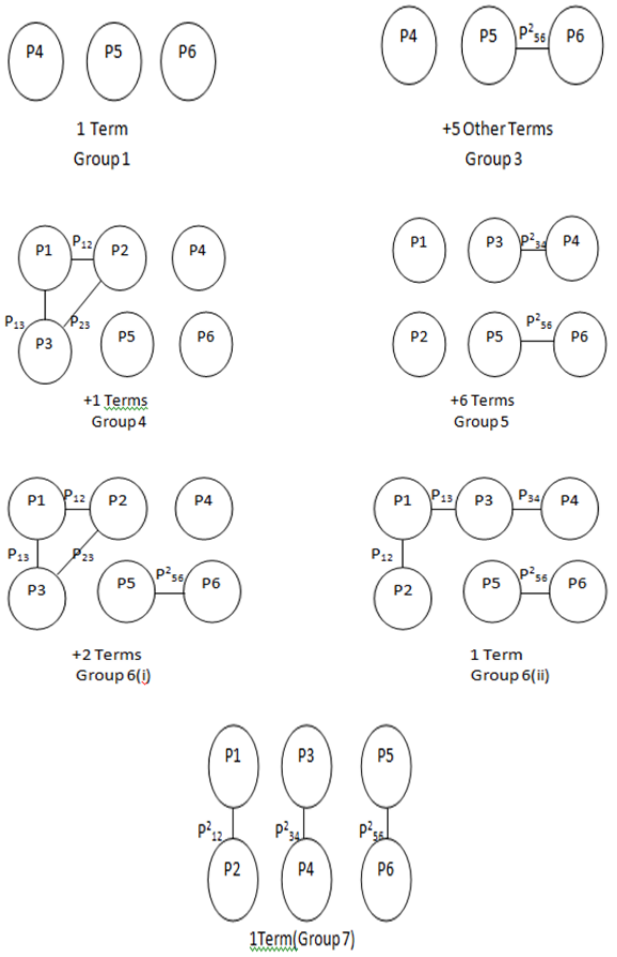

Fig. 5

10. EVALUATION OF PI

The value of diagonal element (P1, P2, P3, P4, P5, P6) of the matrix corresponds to the six subsystems that constitute a PSiOS system are calculated as:

P1=per(EP1); P2=per(EP2); P3=per(Ep3);
P4=per(EP4); P5=per(EP5); P6=per(EP6);

where EP1, EP2, EP3, EP4, EP5 and EP6 are the variable permanent matrix for six subsystems of the PSiOS system. The process of evaluating P1, P2, P3, P4, P5 and P6 is same as evaluating per(E) of equation(6). For the above purpose, the given procedure is being followed:

1. The conventional of these subsystems are drawn separately by identifying their various sub subsystems.

2. Considering the degree of connectivity, interaction etc between different sub subsystems.

11. ANALYSIS OF PSIOS

The methodology for the analysis of the PSiOS system is summarized below:

Step 1:- Consider the PSiOS system. Examine the complete PSiOS system and its subsystems, and also their interaction between the subsystems.

Step 2:- Germinate a block diagram of the PSiOS system, considering its subsystem and interactions along with assumption, if any.

Step 3:- Germinate a systems graph of the PSiOS system with its subsystems as nodes/vertices and edges for interconnection and connectivity between the nodes/vertices.

Step 4:- Germinate the matrix and multinomial representations of the PSiOS system.

Step 5:- Evaluate functions/values of diagonal element from the permanent functions of distinct subsystems of the PSiOS and repeat steps 2-4 for each subsystem.

Step 6:- Identify the functions/values of diagonal elements at antithetic levels of hierarchy of the PSiOS system.

The values of connectivity between the subsystem P1, P2, P3, P4,…., Pn can be shown as a matrix or a polynomial. The sub subsystems again can be treated as an individual system and the following above methodology, we can further break this system into the sub subsystem and the different graph, and matrix and permanent function can be obtained. The process can be taken to the constituent level and further, depending upon the depth analysis required. In some of the cases, it may be possible to find the values of Pij using the mathematical model.

12. CONCLUSION

In this article, methodology used for germinating the system model by identifying all the attributes. Using matrix approach and diagraph these attributes are responsible for production, design and process parameter. It is a strong tool to interact and achieve a degree via modeling in PSiOS system. This tool exemplifies the interaction that affects the design, process parameter and production attributes. PSiOS system is currently working on six parameters. This system consists of diagraph, matrix, and Permanent function. This PSiOS digraph is a numerical representation of functional characteristics and their interdependency is gainful for modeling and analysis. The PSiOS matrix represents a very strong tool for storing and retrieval of data and also for numerical processing. The PSiOS permanent function is a numerical model characterizing the

structure of the PSiOS system. From the permanent function, each term uniquely represent the structure the PSiOS system. An attempt will be made in the future publication to compare these unique terms of permanent function with the parameter like time and space complexity.

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