Providing a model by open framework and evaluation by colored Petri Nets

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Abstract: The purpose of this study is to evaluate organizational architecture by UML diagram and colored petri nets. In this regard, ADM methodology was used to create organizational architecture documentation. The advantages of this method is developing and testing each part of cycle. In this article, an algorithm to evaluate architecture cycle has been provided and the efficiency was evaluated by converting actual model to formal model of colored petri nets.

Key words: *Open group framework; Organizational architecture; ADM cycle; System catalogue; Organizational architecture evaluation; Colored petri net*

1. Introduction

Todays, telecommunication and information technology is increasingly changing and is considered as a new issue in the big organizations. This technology plays important role in most of businesses and achieving these goals without using it is not possible. In most of organizations, different parts of organizations are mechanized in most of organizations to implement tasks rapidly.

To adopt rapid changing, a complete architecture plan of informational tools is needed. Informational systems are informational nervous system of organization.

Organizations should use different framework to develop organizational architecture and by forming organizational frameworks in the organization, the architecture evaluation is provided which use UML to modeling or creating software map to support subjective concept.

In the second part, the infrastructure of the job is considered and is investigated open group framework and petri nets. In the third section, the consistent work the study is investigated. Fourth section is presented the algorithm. In the section five, a case study is provided and in the section six, the conclusion is provided.

2. The infrastructure of the study

The infrastructure of the study is open group framework to develop organizational architecture, integrated modeling language and colored petri net which use user case, sequence diagram and component diagram for modeling.

2.1. Open group framework

Organizational architecture framework which is prepared by architecture society has been developed in the middle of 90s. The features of this framework are that organizations which have proceeded to implement the organizational architecture can merge their previous selected framework with open group.

2.1.1. Architecture development method (ADM)

Fig. 1: ADM cycle

This method forms the core of open group and develops organizational architecture based on organization's requirements. ADM provides a tested and repeated process to develop architecture. ADM include an architecture framework, architecture content development, transfer and controlling

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architecture. All of these activities are defined in the repeated process.

2.1.2. System catalogue

During ADM process, some outputs are produced to collect and provide important output as organized and sustainable form. Open group framework defines a structural model as system catalogue.

2.2. Petri nets

Petri net is a mathematical method to modeling and evaluating software products which was introduced firs by Carl Adam Petri on 1962. Petri net provides accurate and clear concepts, graphic symbol and tools and techniques to analyze self. Petri net is based on graph and indicated the flow of activities in the system using rational regulation.

One of solution to solve the evaluation problems is reducing knowledge distance between architecture and analyst and creating a model.

2.2.1. Colored petri net

Colored petri net was provided by K. Jensen and in fact is a developed version of pet net. In the colored petri net, the symbols, concept of colors, guards and sentences is shown by symbols.

A transition is sent in the petri net, if following situation are provided"

There is a symbol for each of inner place for transition

There is a sentenced for symbol in the inter place.

3. Relevant studies

Several studies have been done about open group framework and also some solutions were provided by UML diagram to modelling to achieve the formal model. Among the relevant approach, Haron abadi approach is suitable to integrating UML diagram and converting to the petri net and Emad approach to annotating and explaining each diagram to petri nets.

Since, to create entry for UML diagram, an organized architecture is needed, Desfray and Raymond approaches include complete explanation of open group framework and ADM cycle and open group framework is needed to create document in the system catalogue form.

4. Proposed method

In the first section, based on open group framework and creating clear entries in UML diagrams, system catalogue is provided to solve infrastructure problems and user diagram, sequence and components is explained for annotating based on architecture outputs and in order to modeling petri nets, all three diagrams are merged and the is evaluated on the petri nets.

Selecting features of open group framework
Providing organizational architecture products in the open group framework using UML
Providing an algorithm to convert UML diagram to formal models
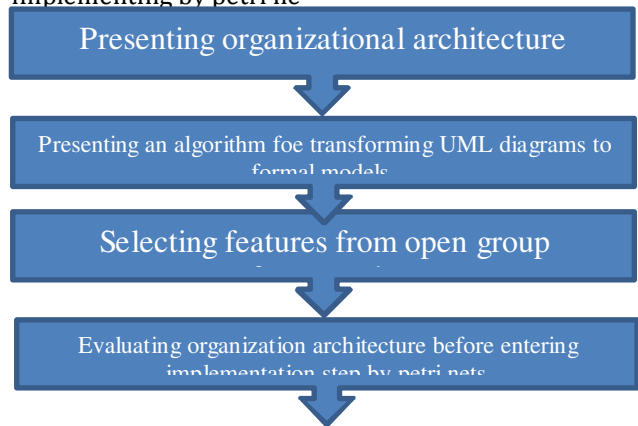Evaluation of organizational architecture before implementing by petri ne

Fig. 2: the route of the study

4.1. Using open group framework in the organizational architecture

The architecture work is done by business principles like architecture principles. The architecture principles are based on work principles. CMMs are best way to evaluate the selected factors during evaluation of architecture development and implementation. The actual level of mature provides a size for organizational ability to change and provide some stages to improve the ability.

There are several caused to limit the architecture activities which should be accepted. Some of the causes include
The organizational influence of architecture team
The goals and concerns of the beneficiaries
The accessibility of the financial and other resources
The selected area for the architectural activities depends on the accessibility of the resource and in the final analysis is related to the feasibility.

4.2. The role of UML diagrams in the evaluation

Software architecture explains the behavioral and structural face in the high level in the system. In order to explain the software architecture, user, component and sequence diagrams are used.

In the explaining software architecture, the component diagram, static structure, behavioral sequence diagram and user diagram are modeled by system.

Since, the user diagram show one or several scenarios. So this diagram is a efficiency concept. In the user diagram, per user is annotated by REuser stereotype. User cases are annotated with Reservide stereotype which are cleared by stem users directly. Reaccessporb and REserviceprob labels are used to show calling probability of the user cases.

The sequence diagram is used to achieve the efficiency model.

RECIMPONENT stereotype by Recomfailprob and Rebpt labels are annotated which show the flow line which connected to the diagram. Also, the interaction between components is annotated by Reconnect or and Recomfailprob label.

Table 1: the evaluation of mature of a process / one organization

level	Criteria
First level- primary	The processes have not been identified
Second level- repeatable	The processes are defined Goals and expectations are specified
Third level- standard	Processes are defined Sub-processes are defined The financial resources are supplied. The human resource are employed The processes are implementing The company save their processes in the memory
Fourth level - management	Processes have defined criteria and integrated vertically. Data use register; analyze processes to explain the future results. Necessary actions are provided to modify the performance
Fifth level- optimized	Processes are measured and managed well. The improvement team are working to improve the processes Company has prvicess improvement program.

Table 2: stereotype and UML labels

Streyotype	Tage
<<REcomponent>>	REcompfailprob REbp
<<REconnector>>	REnummsge Recompfailprob
<<REuser>>	REaccessprob REserviceprob REtypeesp
<<REservice>>	REprob
<<REHost>>	REindeHost REhosttype

Component diagram show components and their interaction in the environment. The applied annotation is same the annotated for the development diagram and include probable of breakdown of communication between components.

In order to combine and integrate UML diagram, introduced stereotype and labels are used.

4.3. Proposed algorithm

Part of software architecture document in the open group framework is provided in context and catalogue and tables. Diagrams which include structures are responsible in the architecture evaluation. In this study, UML is considered as language to documenting software architecture. UML plays important role to provide initial view and

modeling the behavior of a component or a group of component.

Since the final goal is to evaluate organizational evaluation through creating the implementing architecture in the petri net. It seems integrity is needed in the views level. The approaches should be combined. The purpose is achieving a unity approach. Different approaches are created for a system and show total architecture and in fact complement the concept in other views. When there is a combined view, the explanation between main components is clear.

There are several components in an approach and are explained in other approach. For example, module in a module approach is explained to a process in the process relations.

In the several to one explanation, connectors are needed as depends and connected samples as link. Annotating and UML labels are mediator connectors.

In the user explanation, a connection of demands are provided which has PAopenload or PAclosedLoad stereotypes and means we can have a good open petri net (output and input to the outside of environment) or closed petri nets (lack of outside environment).

Using the sequence diagram, the route of petri net is achieved and noted each part of component can be used in the system.

CPN model of T transition and C different color indicate transition in the CPN. Several factors have different work load in the system. In such state, CPN model is separated several sub model of CPN. Each sub model has relevant load work and below features is used to support this issue.

Suppose the system resource is shown RES and shows all reaction which request the service of res

$$ACT = \{act_1, act_2, ..., act_m\}$$

and total reactions of r resources by ACT.

$$identity[r_i] = i \qquad for each r_i \in RES$$

$$RES = \{r_1, r_2, ..., r_T\}$$

Algorithm to convert organizational architecture framework of open group to UML model and then petri nets to evaluate the efficiency of software is shown following:

1) Explaining behavior catalogue of system to documenting open group framework2) Drawing UML model

3) Specifying system features

4) Specify the number of system transition

5) Draw intermediate graph

6) Calculate the break time to evaluate the confidence ability

5)calculating the confidence ability

6)The mentioned annotating is shown in table 3 and is used to create confidence ability of system as following:

User diagram: in addition to explain the task of the system, explain the interaction of internal existence to the system graphically. To measure the confidence ability, like efficiency two parameters is annotated to the user diagram. First parameter

shows the probability of interaction of factor I to system and is shown by qi. Second parameter shows the probability of factor I of user x and is shown by Pix. These annotation are combined to shown the behavior of system x as following:

Equation   (1)

$$P(x) = \sum_{i=1}^{m} q_i \cdot p_{ix}$$

According to the definition, sequence diagram, how to grouping the software interaction is explained to complement the task. For user, there is a sequence diagram, while several sequence diagram is for user mode x and p probable is divided to sequences diagram. Number of period of each component is shown in the in involving situation. Number of involving period with Ci component is shown in the sequence diagram j and is provided as below:

Equation (2) $\theta_{ij} =$

$$prob(failure\ of\ C_{ij}) = 1 - (1 - \theta_i)^{bpij}$$

The probable of break shows the communication with y.

Equation   (3)

$$\Psi_{1mj} = (1 - \Psi_i)^{lint\ eract\ (1,m,j)l}$$

To create evaluation on colored petri net, three equations 1, 2, 3 are merged in the equation 4.

Equation(4)

$$\theta_{s=1-\sum_{j=1}^{k} Pj\ \left(\prod_{i=1}^{N}(1-\theta_i)^{bpij}.\prod_{(1,j)}(1-\Psi_{1,i,j})^{lint\ eract\ (1,i,j)1}\right)}$$

5. Case study

The case study is related to ATM device. Table four shows part of ATM system catalogue using written documentation in the system catalogue and using case diagram for each part is modeled. Figure 3 shows case study of the system is belonged to the ATM device. Component diagram is shown in the figure 5 which leads to using software resource and figure 4 shows total picture of sequence diagram related to request cash.

Route matrix using software resource and number is shown in the figure six. In this section, for each activity, one section and number of reactions are specified. By specifying different parts on the component diagram, adding on section of software to the resource is added to the indicator.

Figure 7 shows colored petri net. Assuming the user case is explained by sequence diagram, there is in the figure 4:

Rational Rose tool and to simulate colored petri nets, CPN tools is issued.

Based on t assumption of UML diagram and modeling of diagram on the colored petri net, the assumption has high to confidence ability and the confidence ability for performance was from average lower. Therefore, the architecture of the organization should have lower break to implement in the future.

6. Conclusion

Based on severe need to a model which investigates organizational architecture in the process, following results are provided:

Using open group framework: using framework to develop previous architecture or new architecture, architecture in each stage evaluate the behavior of the system. In the figure 8, the comparison of several frameworks is provided.

Table 3: catalogue of ATM system data

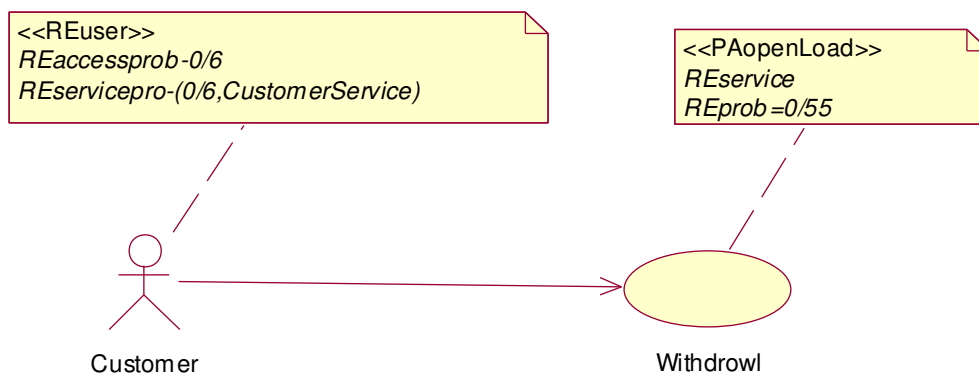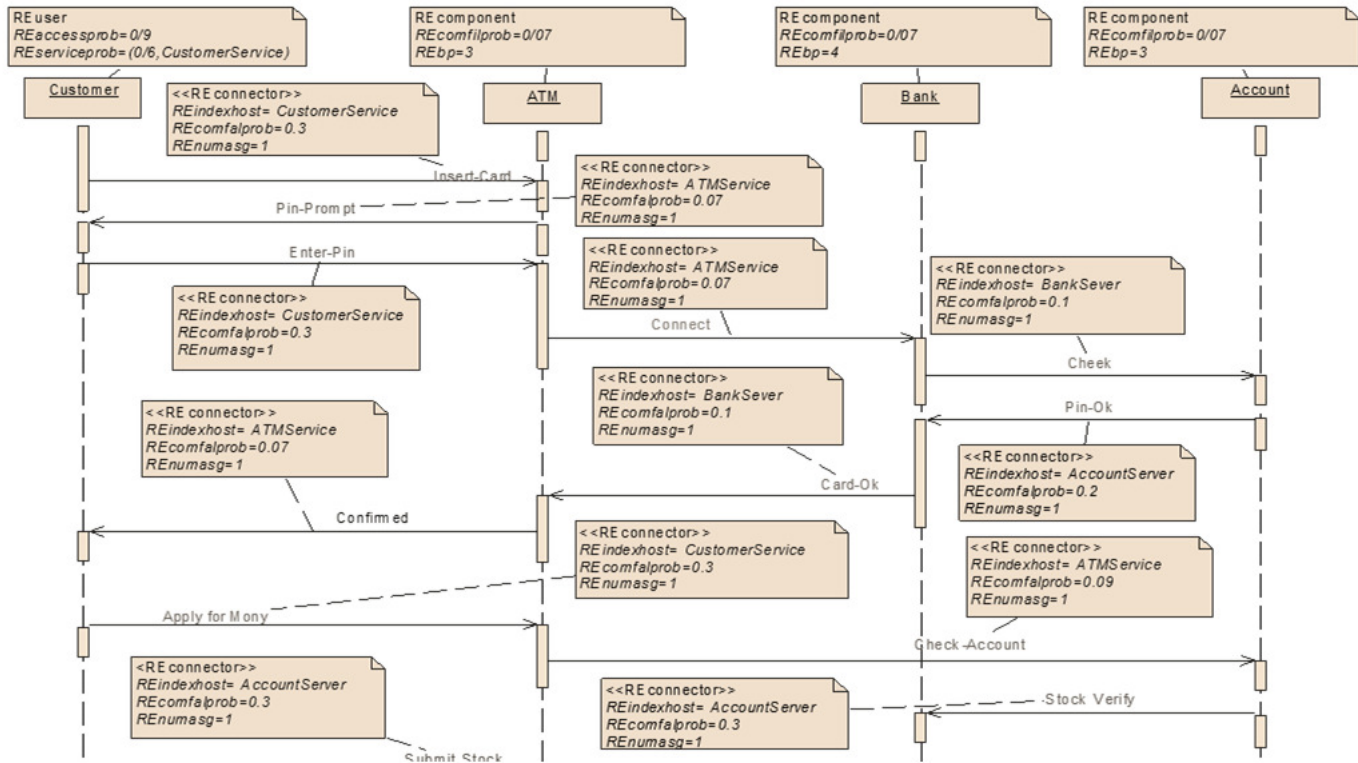| List of services	kind
Data related to architecture business	User account, ATM system/bank /customer
Data of component	User account / ATM/ bank/ custome

Fig. 3: diagram of annotated use case

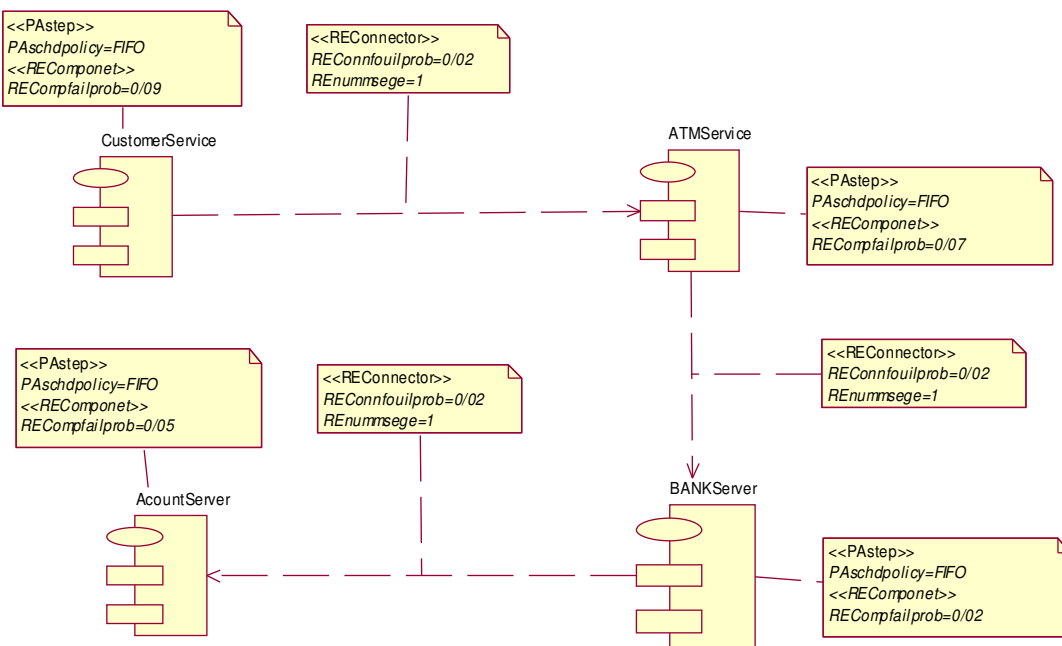**Fig. 4:** part of annotated sequence diagram

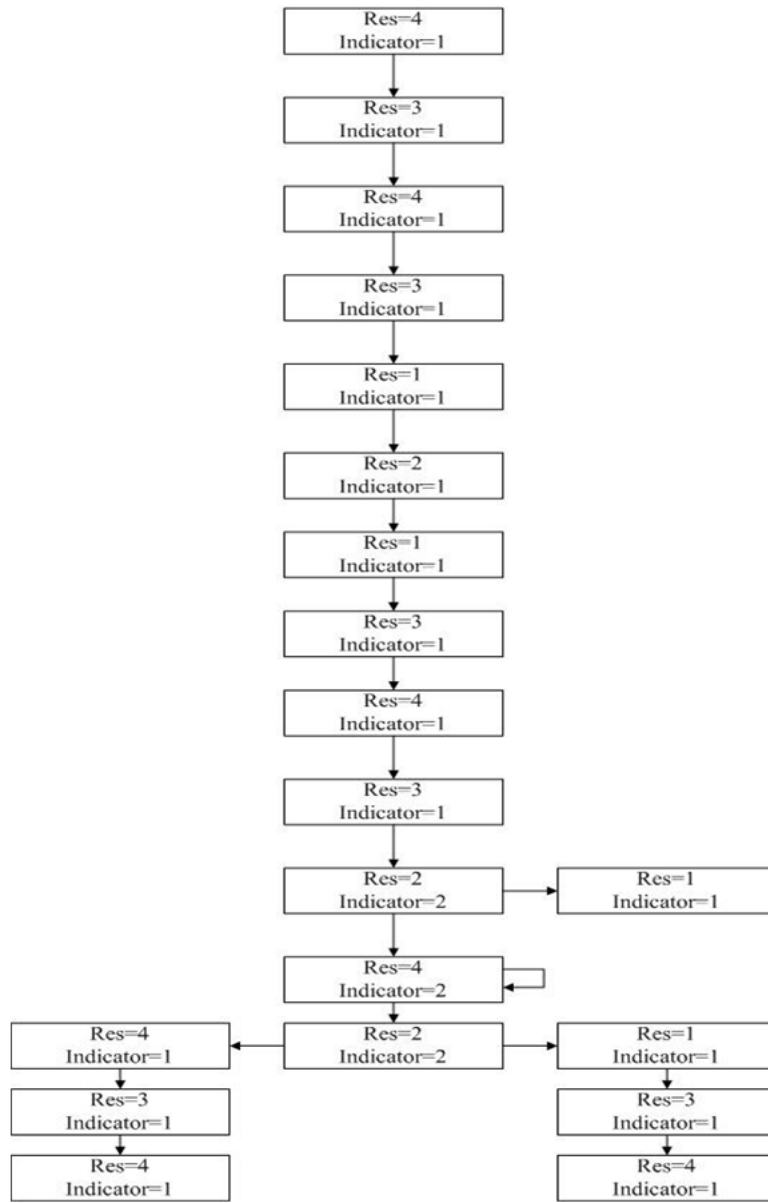**Fig. 5:** diagram of annotated component

Figure 6- mediate graph of above diagram
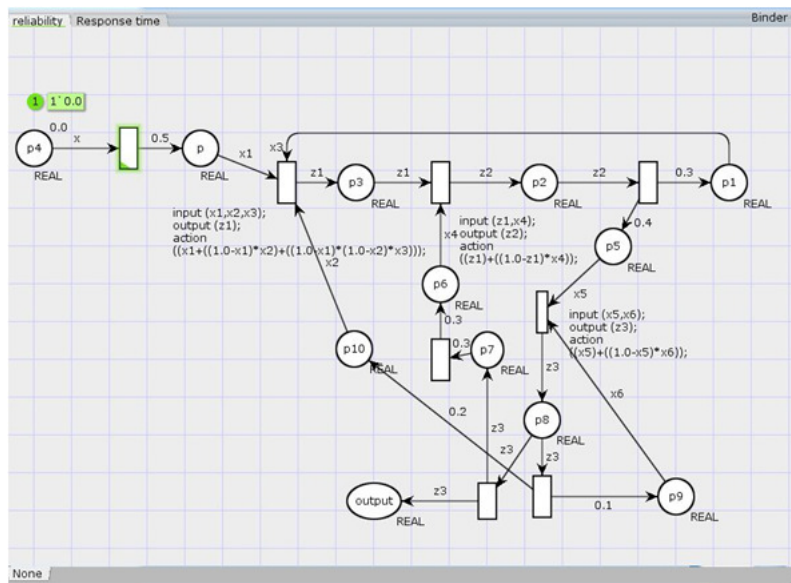

Fig. 7: evaluation of confidence ability by colored petri net

Table 4: comparing suggested models with studied models

Evaluation criteria	Archimate model	Levis model	OSAN model	Suggested model
Reliability	No	Yes	Yes	Yes
Object-orientation	No	Yes	Yes	Yes
Behavior accuracy	No	Yes	No	Yes
Response time	No	Yes	Yes	Yes
Evaluation with uncertainty	No	No	No	Yes
Obtaining neck path	No	No	No	No

An algorithm to modeling architecture performance to a suitable model to evaluate behavior and architecture efficiency: based on the provided algorithm in the article, the performance of the system modeled by use case, sequence and component and the reactions are specified and a model was evaluated by colored petri net. About mastering other frameworks by petri net, figure 9 is suitable.

The proposed model is more reliable compared to above model, in addition to supporting subjectivity, accurate of the behavior and evaluation of efficiency the architecture are considered and is shown in the table 3.

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