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Formal Modeling of Business Processes in Requirement Engineering

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***Abstract*—This paper is on the lines of self-explanatory tutorial. It illustrates the application of a formal method for modeling business processes that occur in a requirement engineering context. Two examples have been chosen for the purpose a car wash business process example and an order processing system example. The advantages of formal modeling methods have been discussed. The formal method used for the work is based on Petri nets. This paper is richly illustrated as an aid to ease understanding. The emphasis is more on the conceptual aspects.**

***Keywords*: Business process, formal method, Petri net, requirement.**

I. INTRODUCTION

Petri nets is mathematical tool for modeling disseminated system and for specific notions of concurrency, nondeterminism, communication and synchronization.[1] Petri net facilitate simple model process organization, asynchronous procedures, contemporaneous operation, and variance or source allocation. Petri Nets have been used for simultaneous and comparable systems modeling and investigation, communication protocols, performance assessment and error-tolerant systems. So in order to compute this many ways are given but simple way is to combine a firing delay with each transition[2][3]Petri Net Model of a Simple Two State System. Figure 1. shows the change of state modeled by a finite state diagram. Note that the circles represent the initial and final states(S1 and S2) and the arrow represents the transition on the occurrence of the event e

Fig.1 Finite state diagram of simple two state systems

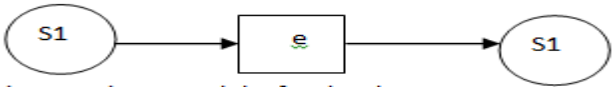

Fig.2 Petri net Model of a simple two state system

Figure 2 represent the same system as modeled by a pertinent. Places represented by circle represent states and transition e is represented by a rectangle. Places and Transitions cannot be the same node. Arcs connect places and transitions, and vice versa[4][5]. Marking of a PN=(P,T,F)- denoted by M is a mapping which assigns a positive integer number of tokens to each place of the net. A marking M (distribution of tokens over places) is often referred as the state of a given petri Net. Notion *t is used to denote the set of input places for a transition t. The notation t*, *p and P* have similar meanings, that is P8 is the set of transitions sharing P as an input place. Figure 3 shows a petri net model of a simple car wash business process whereas figure 4 shows a process simulation corresponding to the model.

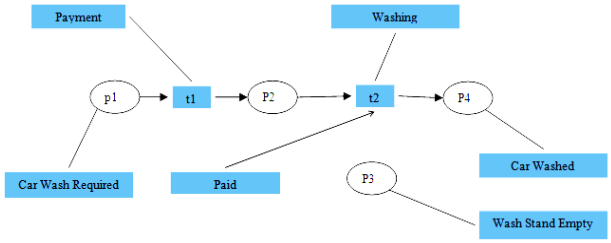

Fig 3. Petri net model of a simple car wash business process

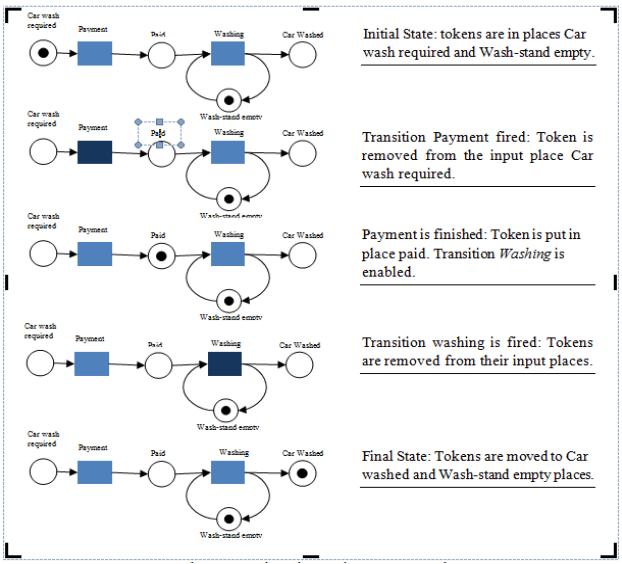

Fig. 4: Process Simulation of a simple car wash petri net model

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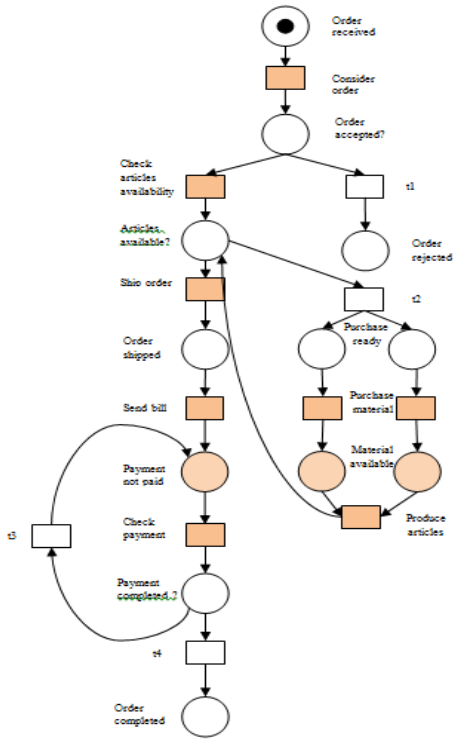

Fig 5: Petri net model for an order processing system

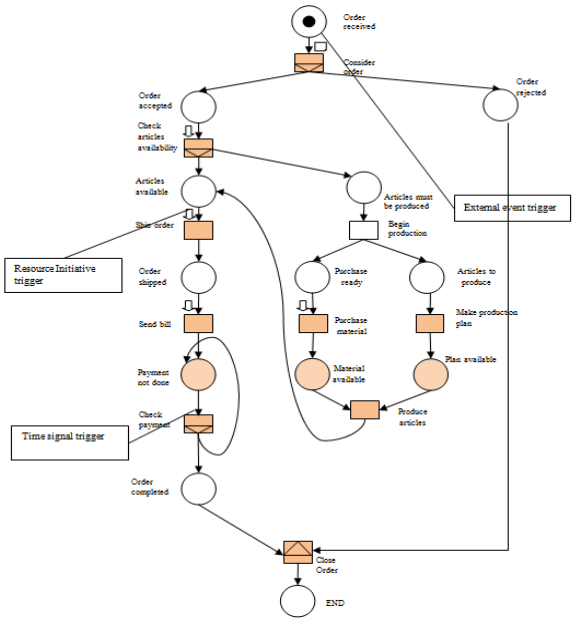

Fig 6: Enhanced WF-Net for Order Processing

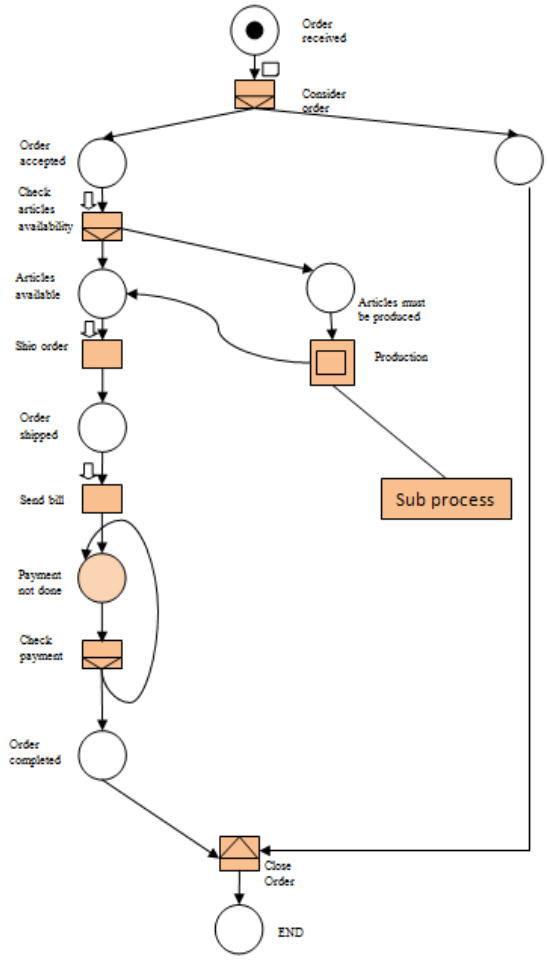

Fig.7. Hierarchical Decomposition

ANALYSIS OF BUSINESS PROCESS

Analysis of business processes is based on analysis of properties inherent to Petri Nets i.e., reach ability, liveness, boundness and others. For the purpose of correct design of workflow the property of soundness was introduced.

SOUNDNESS

A procedure modeled by WF-Net PN= (P, T, F) is sound if and only if every state M reachable from state i.e there exists a firing sequence leading from state M to state o. Further state o is the only state reachable from state i with at least one token in place o and there are no dead transitions in (PN, i). The first requirement states that the moment a token is put in place o, all the other places should be empty. Sometimes the term proper termination is used to describe the first two requirements. The last

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requirement states that there are no dead transitions in the intial state I [6][7][8]

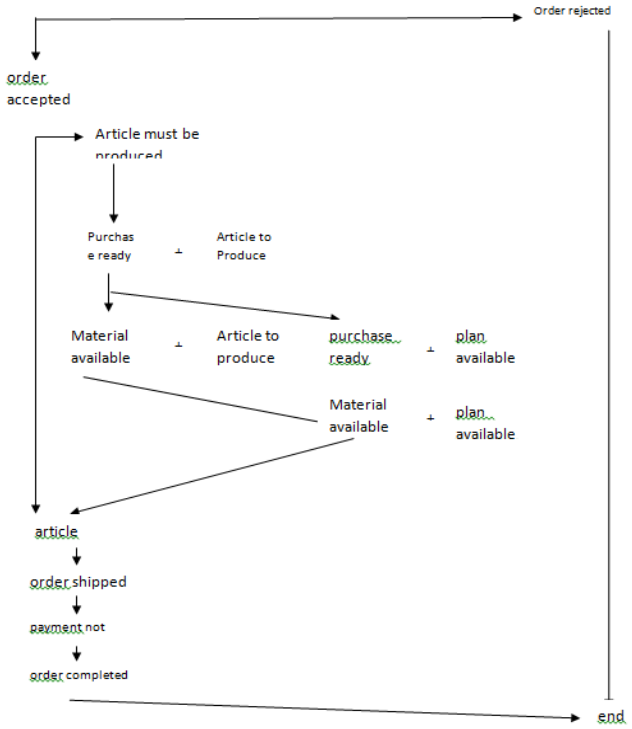

Figure 13: Reachability graph of order processing system

II. CONCLUSION

Two business process models have been chosen to illustrate process modeling(for requirement specifications) with formal methods based on Petri nets. Some of the salient features of using the formal methods are the reduce number of errors in process specification mathematical representation requires more time to obtain results. Further, they are hard to scale up to large systems. The main area of their applicability is critical systems. Here the use of formal methods seems to be cost-effective. For formalizing informally defined processes the idea is to combine formal methods with diagrammatic languages like UML.

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