Study of supply chain management from warehouse to retail store

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Abstract

This paper will discuss the supply chain management system from a warehouse to a retail store with an EM perspective. In the field of EM many models have been made till date discussing the traffic problems and the observation of traffic. Many of those were on the small scale and some of them were on wider scale. For any supply chain to work efficiently and effectively the road transportation is must. How an independent observer can view the problems caused by traffic and can take the decisions to keep the supply chain is moving, is the focus of study. The model will give us the built environment to see the effects which would be caused because of our actions in different problematic situations occurred during the whole process.

1 Introduction

The area of Human-Computer interaction is the vast subject to study in this technology era. These days we have the habit to transform our thoughts to the machine with the means of various programming languages. These programming languages can either be procedural languages or object oriented languages. But one thing which is common in these types of languages is, the programmes developed by these languages are tightly bounded and the humans can not interact with the machine/computer freely. They should give commands to the system which is previously defined by the programmer or developer of that system.

The matter to draw your attention is with this type of computer interaction languages we can produce some extra ordinary software, we were able to go to the moon and we are still exploring the universe. In this whole scenario the control of work done is in the hand of machine only which is pre-programmed. We have believed that what we have made and the path we have chosen for making progress is always the right path. When we get problems with our running systems that time we are almost blindfolded about what decisions should be made to overcome with this situation. The cause of this problem is we have never understood the importance of the different *observers, dependencies and agents* in the system. This is the point where all started. Since 1983 Dr Meurig Beynon and Dr Steve Russ, at The University of Warwick are working to develop the new concepts of computing, to give the new insight of HCI. Their efforts have given the birth to the new concept called Empirical Modelling (EM).

2 What is EM & Why it is different?

How would you define EM? This is the question which is difficult to answer as you can not define what EM is, you can only describe it. One can describe EM as a way to look and think differently. As described in [1] EM is an approach to create an interactive environment to enable programming based on ***identification*** and ***prescription***. These days there is no activity going on in the academic field of thinking programming differently except with EM. People are so confident that they have chosen the right way of thinking and doing interaction with computers by writing programmes. While in EM the programming is not procedural statements. It is based on definitive scripts. The definitive scripts are far more useful then the procedural languages in the sense that you can change the definition very easily which will enable you to interact with the model or software far more easily. This is the advantage of the EM, it provides you an interaction environment.

The interaction provides you with the freedom of innovating things, finding solutions of the problem which has never been occurred and you don't have any clue about the problems. But with EM you can still study those kinds of problems in a model and can get the insight of the solution for that particular problem. These all things are possible as the EM has been built on *Observables, Agents and Dependencies.* In the real world everything is relative with some other things. The human exists on the earth because there are natural resources available. The computers are working efficiently and effectively as there is enough electricity and enough human minds working on how to develop more efficient way of handling the knowledge available within the industry and world.

In a one way everything is dependant on some other things. Let's take an example of simple road traffic system. The traffic on the road depends on various factors like, whether it is a pick hour, population of that area, if it is an industrial or business area, whether the proper traffic lights are in place or not, if there is any road works going on or any accident had happen on that place. These all dependencies affects the traffic of that particular road so when we want to calculate the time between two destinations on that road we have to take all these factor in account. Say if there is an accident on the road then there will be big traffic jam so the time to reach to other destination tends to get infinite till some point. Now as we are stuck in traffic we can't see any other way of reaching our destination, assuming that we know only one way to reach there. So this is the example of small level but what if it's necessary to reach that destination then the person has to find other way. This is the example of how everything is dependant on other things.

In this type of scenario the agents and observables are more useful. Agents will keep an eye on the whole situation from external point. The dependency is more than a perceived abstract relationship between values of variables and express the modeller's expectations about the immediate consequences of changing the values of observations in a situation [2]; observables refers to a feature of a situation that is experienced as having an identity and current status value; while

the agency entails a potential for action that is of a truly experimental character, in that the possibility of taking the action has not been preconceived, and that no prior commitment to the possible interpretation of its consequences has been made. All these major parts of EM lead us to the field of Computer based decision support. The next section will discuss how EM is useful in making decisions.

3 EM for Computer Based Decision Support

The systems which we are using these days for human-computer interaction are simple and largely preconceived [3]. They have escalated in use and sophistication very rapidly. While it comes to the systems like engineering design, learning environments and requirements engineering have made slower progress because of the physical context, or the unpredictability of the environment. The key of applying EM principals to enable effective integration of human and computer activity in taking this agenda is to identify the observables and dependencies belonging to each state encountered in the process of normal construction.

Why we had to rethink the Computer based decision support system with EM perspective in mind while as we know we have advanced in our technology field as well as programming concepts. The main reason is we are living in a real world with full of dependencies, uncertainty, and unpredictability. So when we are making computer based decisions we need to make some observations which can not be pre programmed by any means. EM provides you with the great concept of definitive scripts which is not statements. All definitive scripts are dependant on other part of the model so once something has been changed in the model we can observe the effects that will happen to the whole model and thus based on this modelling concept we can take our decisions in different type of scenarios.

We have used dependencies in making models, observables in observing the effects then what is the use of agents in computer based decision support? Well agents work as our team or experts who will take the decision after looking at the models. The advantage of using EM in decision support is we have an expert who can make the decisions in the unpredicted situations by changing dependencies in given model. Agents are like an eye that will scan the whole model to built the right situation and then to take best possible actions. This flexibility is not available in procedural programming as you can not change the programming statements once written.

EM is far more flexible and efficient in a way of concept then the procedural programming. It can be apply within the range of area like HCI, software development, human computing, artificial intelligence and the most important area is Educational technology which is having vast opportunities to explore. The researchers and students at the University of Warwick have tried to map EM in the all existing areas ranging from the neural networks to business scenarios. From now on the paper will focus on three main areas of EM; Business, HCI and DSS.

4 Introduction to supply chain

Every final product which a consumer buys from stores has been either made in some other part of the world or the material which has been used to make this product is from some other part. So how this thing can reach to us on time? What kind of systems business has put up to manage their supply from production house to a retail store efficiently? As the matter of fact we all know there are mainly four means of transportation available to us, which are road, rail, aircrafts and ships. Now take an account of one business scenario where the warehouse is in Manchester and one of the retail stores is situated in London. In this case the goods to the retail store can be delivered to the store either by road or by rail. For our better understanding we will assume that there is only one efficient way to do this is to transport by road.

Let us examine the factors which can delay the delivery and also the factors which will increase the transportation cost. The two major reasons for not able to make the delivery on time is either stock shortage or the amount of delay caused on motor-ways because of heavy traffic. To keep the supply chain running within the tight time bound one has to look at the broader picture. The starting point of supply chain is the production house. It all starts from how the production house can keep the production going with the need in the retail store. After that it comes to the warehouse, now we will concentrate on the supply chain from warehouse to retail store.

4.1 Different problem Scenarios of Supply chain

We are assuming here that the company has its own transport system which is accountable for delivering the goods. The simple description is to load the goods in the truck from warehouse and deliver it to the retail store. But the real world case is not this much simple, there are so many problems which can occur during the whole delivery system. We will identify those problems and then in the next section will explain that how EM can be used to model the case which will save us the cost and will make the chain faster.

The problems start with the men power of warehouse. While we are planning to load the truck we should know that how much time it will take to complete the task successfully with the available workforce and tools. Sometimes when there is a need to load the truck it is possible that you don’t have enough manpower or machines to do the job, which can cause big delays to deliver the goods. The other problem can occur while there is great amount of demand and the supply or production is very low. Once the truck is on the way to the store there can be traffic jam, accidents, breakdowns, and road works can be major issues of causing delays.

What is the solution for these various problems? One solution is to make a decision support system which will help the human expert to observe the situation and let him take the decisions in crisis situation. If we make the software with the use of procedural languages which are widely and prominently use these

days to make the computer based decision support system then as I have mentioned previously in this paper and according to [3] it will not be fully functioned system. As there are major drawbacks like; bounded language environment, very limited opportunities for human computer interaction, and the important thing that expert can not change the system and take the observations of different type of scenarios. While in all the cases expert's understanding of issue matters most. Now we will observe this situation with EM perspective and what difference we can make by using EM to model this system.

5 Supply Chain study with EM perspective

EM has been based on three main parts as described before Agents, Dependencies, and Observables. In supply chain management these all three parts are perfect match. We have seen the delays which can be occurred due to some unavoidable circumstances. So these delays are dependant on some other events which are out of our reach. We can only observe the occurrence of those events. So to observe the events and dependencies we can have an agent who will observe the things from outside with all the information on his side. There are so many gadgets available these days to help an agent with his observing. Gadgets like cell phone, GPS Navigation system etc. is there to provide information which is required and requested by an agent. If there is a delay on road for delivery van because of any situation then our external agent can track current position of the van. Now say driver is new on that particular route and does not know anything about other alternatives then he can be guided by our external agent to other alternative route.

Now the question which arises is how our agent can guide the driver so he would be able to deliver the goods on time or may be as early as possible. Here our agent has all the power to divert the driver either on a right path or in a wrong path. For his accurate decision making, agent needs to have the knowledge of that driver's position, the traffic situation on alternative road, the time which will be taken for that delivery van to reach at the particular retail store from the specified position. To take such decision agent should be having all the variables of an environment which can affect agent's decision. To help an agent in decision making we can develop the software in a conventional way of software engineering but the problem is traditional software engineering concepts do not deal with the dependencies between various artefacts or situations. Even while software is developed and we want to change the definitions or some parts of functionalities then also we have to make lots of unnecessary changes because of the way we build programmes in traditional way.

When we are making models in EM we are providing definitions and scripts for the computer to work. So if in the end we want to observe some changes in environmental variables affecting our model then we only have to change the definition for that variable and model will produce the answer or solution which is required. Other benefit of using EM is we will be able to consider the

dependencies in our model, which is very important in supply chain as everything is dependent on other variables. An agent can make decisions according to defined model with dependencies which will provide whole wide range of scenario to that agent. Thus an agent can take decisions based on model and can know the things happening out there with the observables' observations.

5.1 The Model

In the previous research work of EM the warehouse model has been developed, which I used as a base for my modelling purpose. As we can see in the figure there are 2 paths to reach to our destination, retail store, in this case. We have already assumed that we have only road as the only transport option. In our model there are 2 paths to reach our destinations.

1. Path A
2. Path B

Path A is 300 miles long while path B is 350 miles long. So Path B takes relatively more time then A. But for our modelling simplicity we have assumed that path B is not having many road blocks or delays. So path A is the heart of any transportation or commuting purpose. The next section in model is speed, as we can see there are only 3 options available right now but we can increase the options according to our requirements.

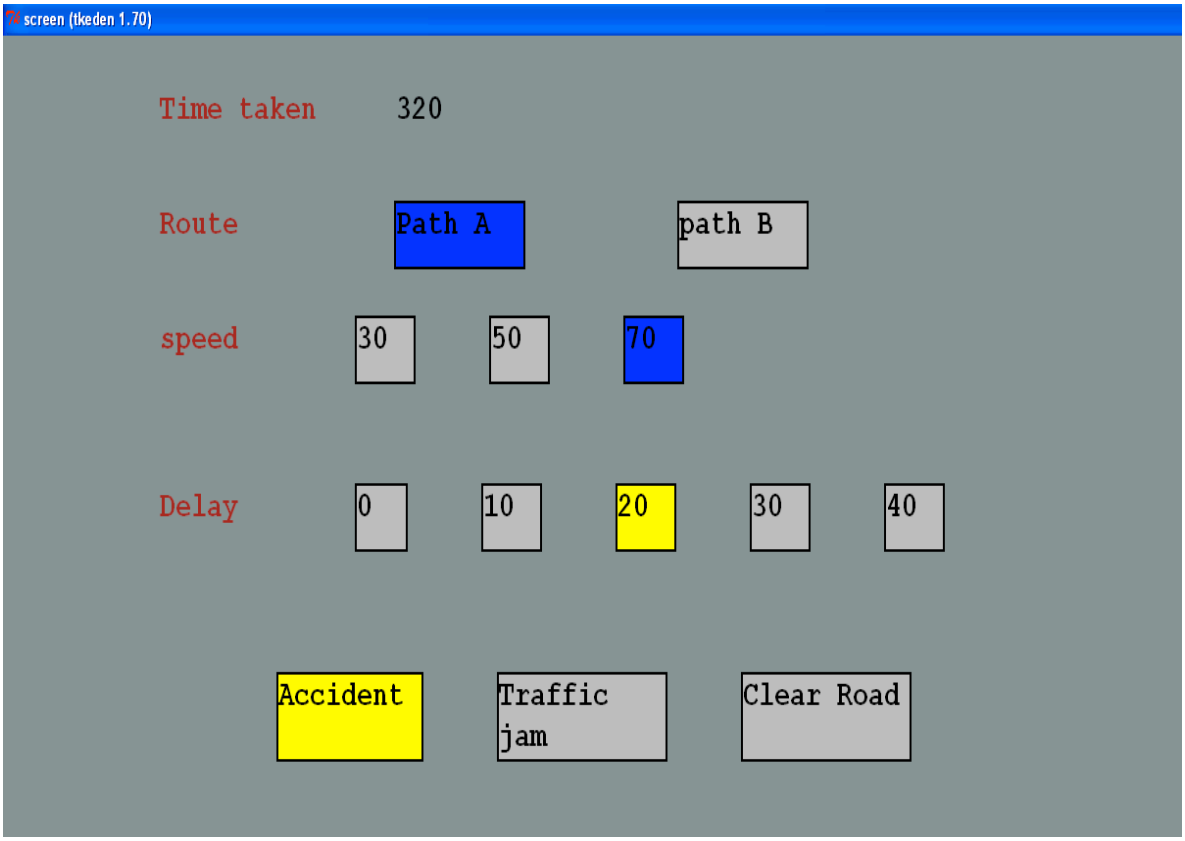

Figure 1: Model for supply chain management

Then I have also considered the delays which can be caused by the workers at warehouse on loading the truck or may be by the driver or any other circumstances. And finally I have tried to cover the accident or traffic jam delays in delivering goods. The time taken to deliver the goods is calculated in minutes. First the distance is divided by speed and then the delays are added into the answer. This shows that the final time is dependant on various other parameters like the speed, distance, delays, accident. So the manager, an agent in EM, can observe the thing and make decisions according to the situation. He can guide the driver to take an alternative route or to change the path over cell phones. And as these days there are GPS systems available easily, so you can quickly change the route and still you will reach the destination. In the given figure goods will take 320 minutes to reach the destination as the accident happened on the way plus there were some other delays as well.

This model does have some limitations like in giving user input. But as it is built with EM and definitive scripts, it is easy to modify the model in quick time. If user wants to modify the speed then he just has to change the definition and he will get answer based on the new speed. This is the power of EM. And this is how it is different from traditional programming.

6. References

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