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SIMULATION AS EDUCATIONAL SUPPORT FOR PRODUCTION AND LOGISTICS IN INDUSTRIAL ENGINEERING

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ABSTRACT

The proposed implementation is a monitor system able to train operators for on-line real time manufacturing control in order to analyze the performance of a production process. This system integrates a simulation model and a statistical analysis module. The architecture has been designed to be able to operate in a real time distributed environment, by using TCP/IP sockets; obviously this approach makes it possible to access the data by different users with a hierarchical architecture. This innovative approach pays great attention to make a use friendly network support training for both operatives and managers thanks to the portability and scalability of the system. The methodology has been tested on a real case study and the experimental results demonstrate the potential of such an approach.

1 INTRODUCTION

Since the beginning of the 80's smaller firms have been producing the secondary components so that the main automobile firm could concentrate its efforts and resource on the production of the fundamental component. Today's trend is to give the high value outstanding therefore not concentrating effects on component production.

Warehouse have a great influence on costs and more in general on the firm management, therefore a correct management of warehouse has an extreme strategic importance. Each operative division need a stock of raw material, semi-finished product and consume material to which you must add the utensils.

Let now consider two firms with the same production volume, with a different production mix: one which concentrates on a single product and the other which produces a variety of different products. It is possible to notice that the first firm has a higher profitability (Mosca et al. 1999). In fact, the working of one single production leads to two mayor advantages: it is easier to optimize production and to cut warehouse coats. The production of different component implies a number of common resource along the "working flow", therefore if a production delay occurs regarding one component it would result in a general delay on the firm's production as a whole (Chase et al.1995).

By producing two different kinds of items in a distributed production plant, in which two different process are merged, the break down of a single line make dramatically reduction in the over all performance. It's obvious understanding that more production lines are integrated, much complex is to manage them; in order to help operators and managers to manage such production plant the authors developed the tool that allows both warehousing and production control as well as solve some transportation problems.

It is important to underline that today industrial and commercial situation strictly depends on information system development. The possibility of checking system information with computers make easier to control the production. Moreover, the E-commerce explosion has focused management attention onto Information Technology (IT).

For many firms, IT provides a competitive advantage. Though this has been for some time in service industries such as Banks, it is also becoming more relevant for firms as large retailers airlines, and manufactures. Today an increasing number of companies are providing value-added IT-based service to their customers as a way of differentiating themselves in the marketplace, and developing strong long-term relationships with their customers. To utilise information, we need to collect it, access it and analyse it. Our goals are:

- Collect information on each product from production to delivery or purchase point, and provide complete visibility for all parties involved,
- Access any data in the system from a single point of contact,
- Analyze, plan activities and make trade-offs based on information from the entire supply chain.

The primary goal of IT in the supply chain is to link the point of production seamlessly with the point of delivery or purchase (Bruzzone, Giribone 1998).

The idea is to have an information trail that follows the product's physical trail (Simchi-Levi et al. 2000). This allows planning, tracking, and estimating lead times based on real data. Any party that has an interest in the whereabouts of the product should be able to have access to this information. Information and the products flow from the supplier to the manufacturer, internally through the manufacturer's distribution system, and then on to the retailers (Kenneth 1997). Evidently, the retailer needs to know the status of its order and the supplier need to be able to anticipate an incoming order from the manufacturer.

2 THE GENERAL ARCHITECTURE

In order to train operators and manager of a production is necessary to assure the correct information flow from the supplier to the retailer. Suppose to manage a set of Workstation, as shown in Figure 1, part of a single production plant we may build an architecture that could spawn the control system on a wide area by using Internet Sockets and allows Workstation to be interconnected without any regards in term of geographical distance.

Data coming from the server application will be used to tailor a simulation model built in AutoMod™ environment, by mean of a client application, in order to provide information on a future evolution of the system and train the people to take the correct action to optimize the whole production process.

The implemented approach could teach how is possible to assure the customer the possibility to respect the due date as well as the various milestones.

3 THE TOOLS' IMPLEMENTATION

The plan has been developed on two different aspects: the creation of the management software and the integration

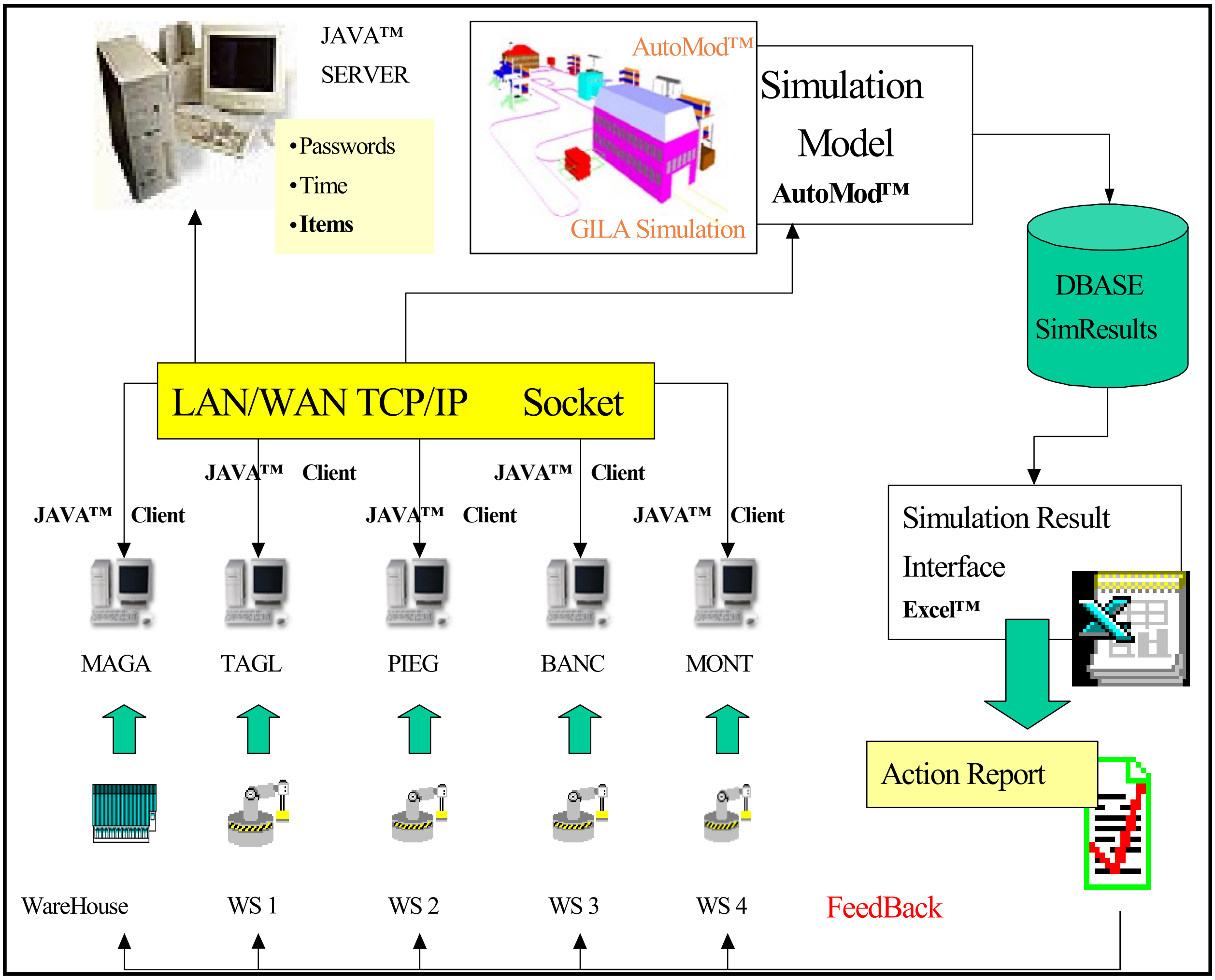

Figure 1: The General Architecture

with a faster than real simulator tools on-line (Bruzzone, Giribone 1997).

3.1 Management Education Software

The program is a set of user friendly interfaces built in JAVA™ language located at every workstation in order to save time in the data updating. The client side of the application is designed to solve three different problems:

- managing the material flow walking around the production process,
- monitoring the transfer time from the various station, update the system password and authorization.

The material flow management client at start up requires a password to connect to server, from this moment the connection is protected and the operators can take some action such as:

- add a new item,
- move an existing item among two different location,
- delete and substitute an existing item (that means complete a assembly or disassembly task),
- locate an item,
- obtain the whole list of items,
- save and load warehouses.

A sample screen is shown in Figure 2.

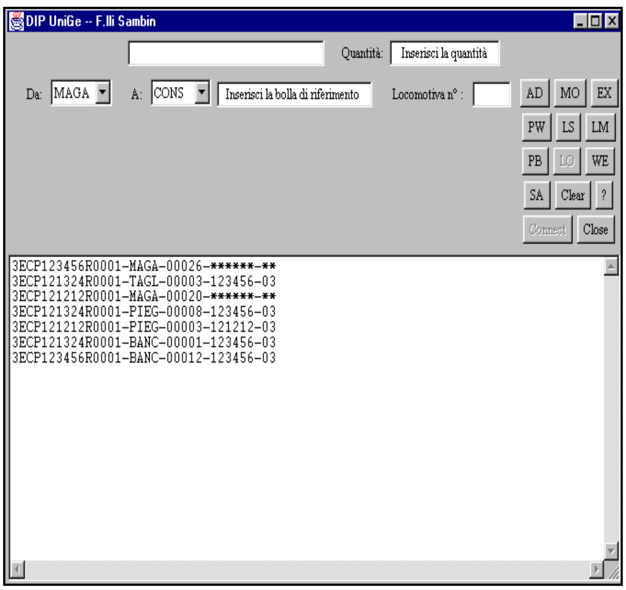

Figure 2: The Management Trainer Interface

All the action could be taken also by using a Telnet application in character operation mode, that allows user to be connected without having the client side application.

3.2 Simulator Education System

In order to simulate our system we have left from a real case: a company that makes locomotive's pipe and electrical parts. With Automod™ we have modeled the present reality, the workstations, the moving system. In the way to obtain a real life representation: every workstation has a distributed time of working distributed as a uniform random variable and there is a level of breakdown. The simulator, as often is required, after connection to the server, captures the data of the current working and simulates the future production behaviour. The output data the simulator model are stored in a database, and are captured from one macro of Excel™ (Figure 3) and are sent, through electronic mail, to the workstations.

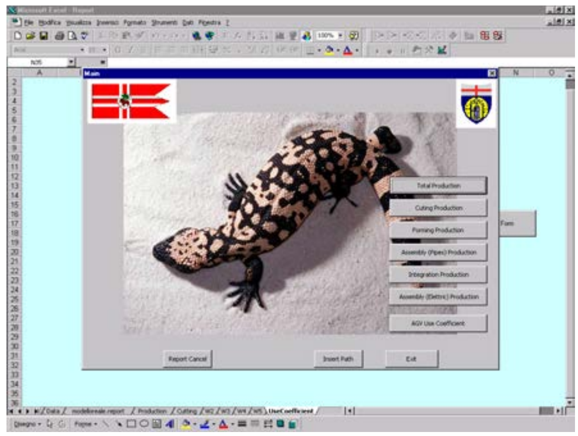

Figure 3: The Excel™ User Interface

First, data obtained from the model are used to estimate the correct simulation run by the MSPE's time evolution (Giribone 1994). Excel™ implements the MSPE evolution curve, inserting the five replications of the preliminary twenty four days run (one working month). Given the number of hours to simulate, Excel™ produces the diagrams of the production and the usage coefficients of the resources (AGV, Workstation).

The first objective was to optimize the production system, so authors settled on a two factor central composite design (Bruzzone, Giribone 1998). The factors to optimize would be many more (Mosca et al.1995). What is under study are: the number of AGV and the flow of the raw material from the main contractor.

Therefore it is has obtained the production function according to the two listed factors, and the optimal production throughput time was found.

4 THE IMPLEMENTED SIMULATION MODEL

The simulated system is a simple set of Workstation connected with AGV at a final Warehouse in which the items were stored (Banks 1996). The AGV use drives the authors to apply AutoMod™. In Auto-Mod™, AGV were easy to implement such as the conveyor. Moreover, AutoMod™ offers a quite simple interface with C++ programming (Automod 1999).

AutoMod™ has a good graphic interface: our system is shown in Figure 4. All graphics are represented in 3D space and scale with unlimited viewing control, including translation, rotation, scale, light sourced solids, perspective, and continuous motion viewing. AutoMod™ provides true to scale 3D virtual reality animation, making simulation models easy to understand and invaluable for communicating new ideas or alternatives. When all aspects of an operation are viewed in a 3-D animated model, communication between management, production and engineering is dramatically improved.

Our tool is devoted to the spare parts production for locomotives, so we have to design the moving systems for large goods. AutoMod™ is able to manage the item sides both for handling and both for stock keeping.

5 A REAL LIFE APPLICATION

The control system of multi Workstation factory is composed in many sections. Every Workstation is provided by a PC which is used as a client; in the PC are available the information about the productive process of its workstation. Data include the number of Work In Progress (WIP), number of stocks and number of waiting process. Every client are connected by a web Socket, that allows the Internet use, at many server, see Figure 4 (Bruzzone et al.1999).

On this server is the software that manages the entire system (Lorenz 1993). Every time a task is completed the items must be transferred in the next working point by using an AGV system and the software provides the new location information to the general data base. In this way the Client\ Server architecture is able to supply real time update information of the various items location and solve inventary problems in a very proper way (McConnell 1996).

Examining future production scenarios is aim of the Automod™ linking that the authors developed by means of a C\C++ interface. With Automod™ we try to simulate the real system with real life data available on the server. At the end of the simulation process, an Excel™ interface was implemented in order to obtain an action list report that can help managers make decisions on the production system.

6 CONCLUSIONS

The possibility of an integration between distributed database and simulation model was proved to be very effectively to solve the managing problem in a very proper way.

The results presented in this paper are related to a real life industrial case and could be easily extended to other production situations such as: manufacturing, job shop and

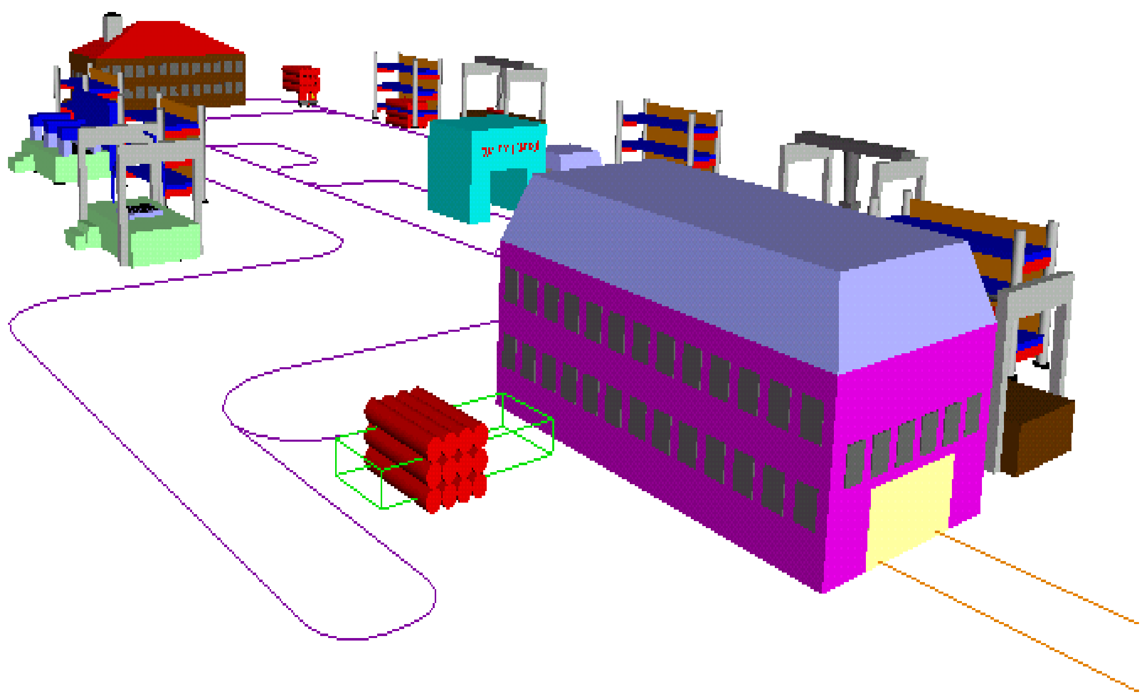

Figure 4: The Automod™ Simulation Model

services. The implemented tool allows both distributed training across a LAN as well as over the Internet and has proved to be very effective in the experiments we conducted.

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