SMEs PRODUCTION MANAGEMENT: A CASE STUDY

Alexandru Valentin Radulescu[1], Radu Mircea Carp Ciocardia[2], Robert Florin Vizitiu[3], Irina Radulescu[4]

[1] University POLITEHNICA Bucharest, varrav2000@yahoo.com
[2] University POLITEHNICA Bucharest, carp@omtr.pub.ro
[3] University POLITEHNICA Bucharest, robert.vizitiu@gmail.com
[4] S.C. ICTCM S.A. Bucharest, irena_sandu@yahoo.com

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Abstract: The present paper presents a simulation of the production management for SMEs, using the supply chain method. Methodologies based on simulation are attractive when dealing with supply chain systems. They allow both material and information flow to be modelled, as well as sophisticated decision logic for planning and control. Simulation can deal with stochastic environments, non-stationary demand patterns, capacity constrained resources, assembly coordination etc. Finally, various planning and control scenarios were compared, based on demand patterns, product structure and processing characteristics.

1. INTRODUCTION

The paper proposes a case study which is related to a Romanian SMEs that produces and distributes medical devices. In such factories, production management usually takes place without the support of modelling and simulation although such methodologies have proved to be very effective and helpful. Main reasons for that have to be investigated in the high costs usually associated with a simulation study, especially for data collection, model building and model validation. In order to avoid this problem a general-purpose simulation framework was designed enabling self-build according to production process information stored in a relational database.

Methodologies based on simulation are attractive when dealing with supply chain systems. Simulation can also deal with stochastic environments, non-stationary demand patterns, multiple performance criteria, capacity constrained resources, assembly coordination etc., [1], [2]. In general, any degree of detail can be modelled, eliminating the need for simplifying assumptions and constraints. The literature presents the use of logistics laboratories to easily and quickly build models representing integrated supply chains, [3]. Also, it can be identified the need to integrate production and inventory planning and control models with distribution models, [4].

The authors successfully applied modelling and simulation in order to build decision support systems able to quantify the effect of the management on the entire production process and its economical aspects, [5], [6]. In the proposed approach well-known best practices designed for bigger industries have been specially tailored to fit the SMEs requirements in term of costs and implementation time. The proposed simulation approach was implemented in ARENA 10 free version software according to 3 main phases.

The first of these related to data collection by identifying work flows and process times of the various operations while identifying the more appropriate statistical distribution. Second and subsequent phase involves the implementation of the model as well as the integration of the simulator with ad hoc relational databases designed for supporting verification and validation procedures. The simulation model is, in fact, connected to the database in order to overcome the limits of the generally available simulation package in reporting and result collection.

The model logic was implemented in a generalized way in order to foster flexibility. The Arena building blocks, in fact, have been used to simulate an high level flow shop where an tailored entity is driven directly by an attributes set defined in a relational database. Such an approach can be adapted to a wide variety of industrial application

without a massive simulation effort. In the third part of the project the functional relationship between various factors have been investigated in order to find better configuration for the manufacturing process as well as investigate the better planning process.

2. THE SIMULATION SOFTWARE

Arena Basic Edition software is a product of the firm Rockwell Software and enables creation of very large models, capable to model and simulate the business process and the manufacturing system. It is designed primarily for newcomers to simulation and serves as an introductory product and foundation to the rest of the Arena product family. Arena is very intuitive tool with user-friendly graphical user interface and is also compatible with MS Office – enables data input or output in .xls and .txt data format. Output reports are very transparent and detailed.

The working worktop of Arena can be divided into three parts:
- Panel of modules – where are available libraries of modules for a user;
- Working part – where is the model created by user;
- Data part – where user can modify parameters of resources and entities.

Typically, any process that can be described by means of a flowchart can be simulated with Arena Basic Edition. Arena Basic Edition is most effective when analyzing business, service, or simple (nonmaterial-handling intensive) manufacturing processes or flows. Classical scenarios include:
- Documenting, visualizing, and demonstrating the dynamics of a process with animation;
- Predicting system performance based on key metrics such as costs, throughput, cycle times and utilizations;
- Identifying process bottlenecks such as queue build ups and over-utilization of resources;
- Planning staff, equipment or material requirements.

Figure 1 presents the simulation model used for modelling the supply chain specific for the studied SMEs.
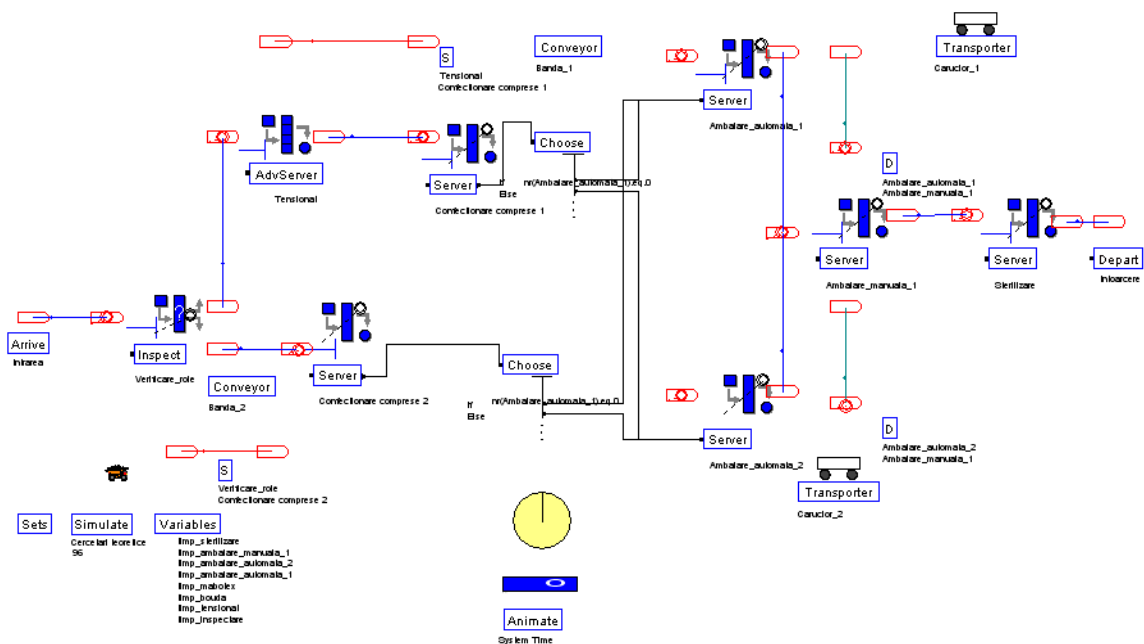

Figure 1. Simulation model for the supply chains

3. METHODOLOGY AND RESULTS

The first stage of the modelling was the data collection and the study of the process beside the manufacturing plant, regarding the flows, the processes and the times of each single operation seen (Table 1). Data collection was carefully conducted in order to not interfere with the production reaching a good level of fidelity. This phase is very important since it allows a full comprehension of the simulated system enabling the manager to better understand the underlying processes and avoiding the risk that the modeller follows his vision of the system.

Table 1. Flow analysis of production and packaging in terms of number of workers

Endpoint name	Number of machines	Number of workers on one machine	Number of hours worked
Inspection	1	1	8
Tension	1	1	8
Manufacturing compresses 1	1	1	8
Manufacturing compresses 2	4	1	8
Automatic Packing 1	1	1	8
Automatic Packing 2	1	1	8
Manual Packing	-	6	8
Sterilization	1	1	8

A full scale distribution fitting process was adopted in order to identify the best distribution for the processing time, and a relational database was implemented for hosting the production planning. This phase was necessary as starting point for the upcoming production planning control that is under implementation. Generally speaking timing distribution was assumed from triangular model where no other information except expert opinion was present. This data have been collected following ad hoc schemas where sequences, resources seized and the mean time for each operation were kept.

The main results regarding the production management are the resource scheduled utilization (Figure 2) and the number of entities allocated to each resource (Figure 3).
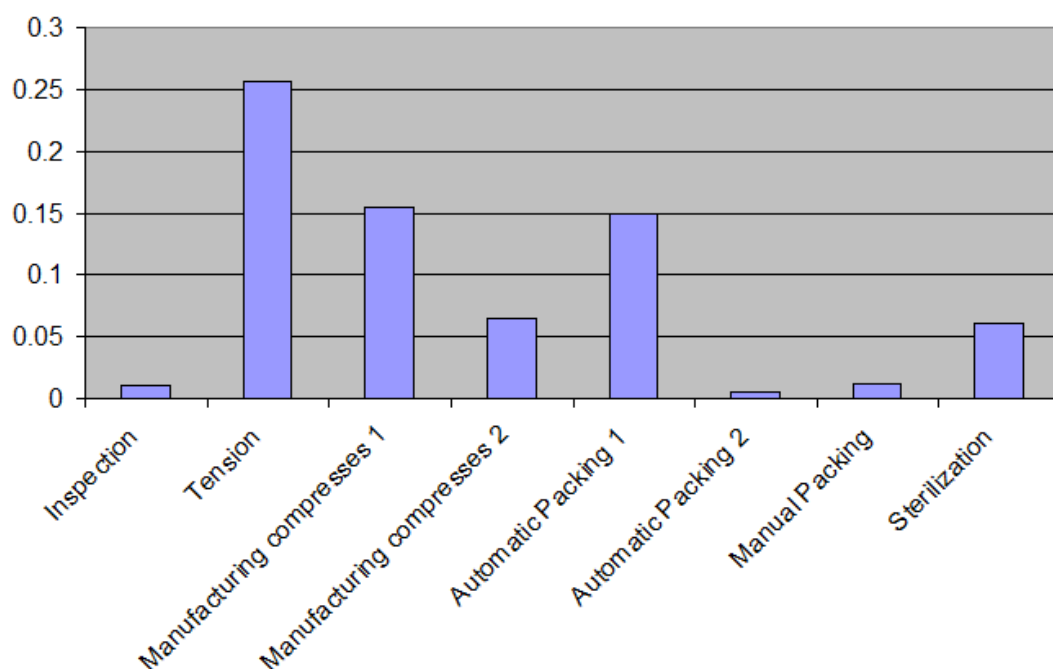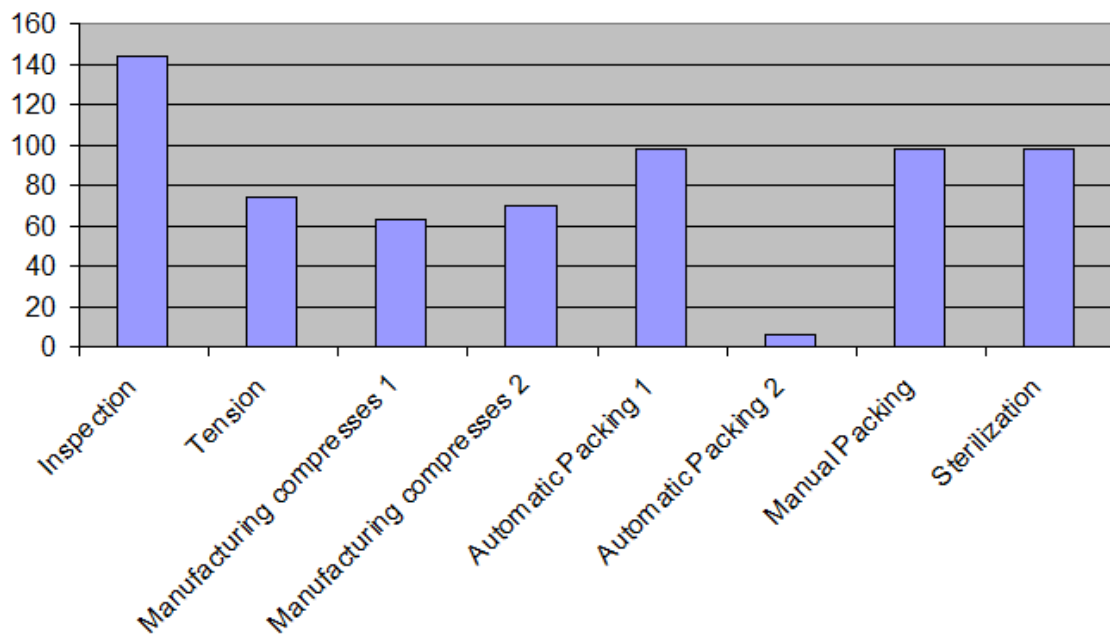

Figure 2. Resource scheduled utilization

5.256

Figure 3. Number of entities allocated to each resource

4. CONCLUSIONS

The paper demonstrates practically the applicability of the proposed methodology to a real-life application. In particular the implemented simulation framework demonstrates a high degree of flexibility serving different simulation exercise with minor changes. The workflow structured in a relational database instead of into the simulator itself fosters reusability and interoperability reducing dramatically the time and cost requirement of a complex simulation application.

The simulation was intentionally designed to work with small problems and therefore is not intended to model real companies or supply chains. Many of the features could be incorporated into a model on a large scale. However, computational and communication efficiencies then become significant considerations. The use of database tools and alternative architectures could make this feasible.

Obtained results have shown great potentiality in identifying relationship among Key Performance Indicator and ad hoc objective function enabling managers to easily identify and evaluate strategies and criticalities.

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