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SUPPLY-SIDE MODELING IN A TOTAL ENTERPRISE SIMULATION

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ABSTRACT

This demonstration session will discuss the role of supply-side management and demonstrate its use in a total enterprise simulation. The goals of this session are to present constraint modeling as a valid supply-side modeling technique in a total enterprise simulation. The simulation utilized seeks to model these techniques to more accurately simulate supply-side decisions made by managers of a small manufacturing firm. It is hoped that this session will help attendees assess the benefits and challenges associated with using a comprehensive total enterprise simulation

INTRODUCTION

This paper looks at supply-side modeling in a total enterprise simulation. First the paper examines the decisions made in a typical total enterprise simulation. Next the paper discusses supply-side modeling in general and sets forth another method of supply-side modeling then is generally used. Thirdly the paper reviews supply-side modeling in a specific total enterprise simulation.

SUPPLY-SIDE DECISIONS IN A TOTAL ENTERPRISE SIMULATION

Figure 1 provides a view of the important decision flows in a total enterprise simulation with focus on the decisions made by supply-side managers. Decisions about supply begin with the desires of the consumer as interpreted by Marketing. Once there is a determined demand, supply-side decision-making moves to answering the resource questions that begin to formulate the Production Plan. Key ingredients to the plan are the people, equipment and raw materials needed to support production. Finance must deliver the cash to purchase the equipment, supply the raw materials and support the rest of the operating budget. Human Resources and R & D contribute toward improving productivity that in turn affects costs and quality of produced goods. Scheduling the provided resources and managing inventories are the focuses of the Operations function.

SUPPLY-SIDE MODELING

In many business simulations, supply-side modeling

Figure 1 Decision Flow in a Total Enterprise Simulation

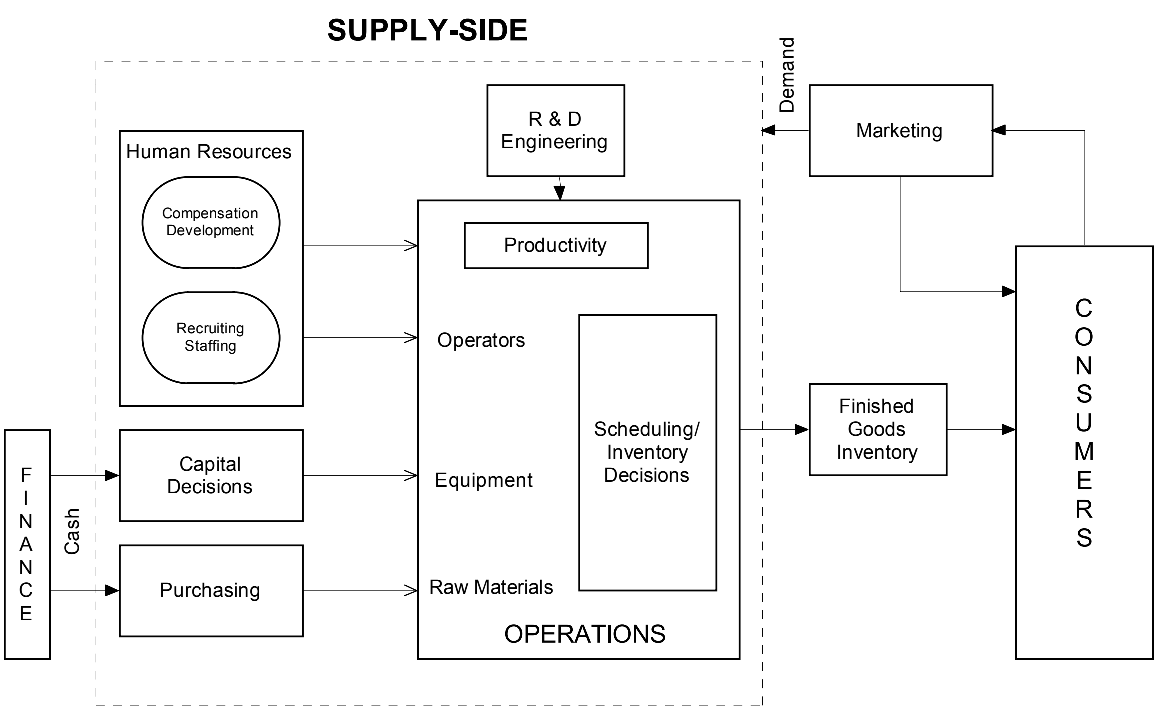
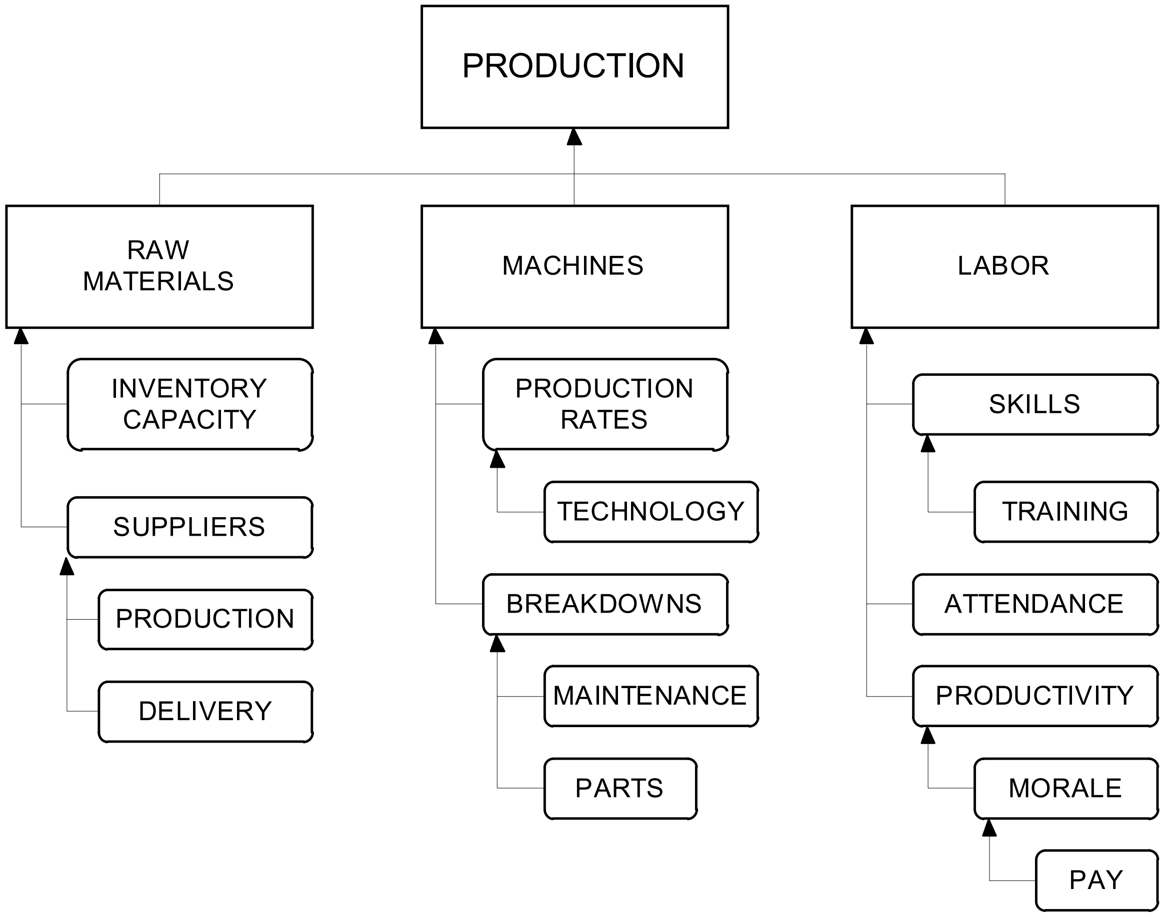


Figure 2 Example Production Constraints



combines cost and production functions found in economic theory. These functions are analytic and include a limited number of variables. Factors affecting production are many and varying. This suggests a different approach to supply-side modeling. Perhaps a process of modeling that takes into account the many constraints inherent in such a system. Goldratt provides a philosophical underpinning for this approach as shown next.

"The Theory of Constraints (TOC) is a philosophy of management and improvement originally developed by Eliyahu M. Goldratt and introduced in his book, "The Goal". It is based on the fact that, like a chain with its weakest link, in any complex system at any point in time, there is most often only one aspect of that system that is limiting its ability to achieve more of its goal. For that system to attain any significant improvement, that constraint must be identified and the whole system must be managed with it in mind."

In supply-side modeling for production, some of the constraints described above would include cash, materials, machines and labor. Each of these constraints is constrained by a series of other constraints that precede the ones listed. Figure 2 provides a simple flowchart of some of the constraints in this hierarchy of supply-side decision-making. For example, production is dependent upon labor that in turn is influenced by their skills, attendance and productivity. Their productivity in turn is affected by their morale, which might be affected by their pay. In order to provide comprehensive supply-side modeling, each of these constraints must be modeled within the total enterprise simulation.

SUPPLY-SIDE MODELING IN BUSSIM STRATEGY

BusSim® Strategy is a total enterprise simulation that seeks to model both strategic and operational level decisions made in a small manufacturing firm. All four functional areas are modeled with equal complexity so as to provide a balanced assessment of each student's contribution to the firm. It is the responsibility of the student teams to be sure that all resources and contingencies are part of their planning. This paper focuses on the supply-side decisions made by both the Human Resources and Operations functions. BusSim® Strategy utilizes a stochastic simulation model, recognizing that most business decision results can vary. Most other business simulations utilize a series of deterministic equations that do not account for uncertainty or randomness.

Figure 3 Some Factors Affecting Production in BusSim® Strategy

Production -->

- Labor
  - Operators by skill
  - Productivity
    - Morale
    - Development
    - Compensation
- Equipment
  - Production Rate
    - Age
    - Maintenance
  - Cash
- Materials
  - Raw Materials
    - Suppliers
    - Ordering
    - Cash
  - Parts
    - Fabricating
      - Schedule
      - Prod Rate
- Random Events
  - Breakdowns
  - Replacement parts
  - Operator Issues
    - Psychological
    - Drug/Alcohol

In this simulation, production is determined by scheduling the available resources. Production can only take place if the necessary resources are available. Some of the things that limit production are shown in Figure 3 below. For example, if raw materials do not arrive on time, production for all areas affected will shut down. If an operator is absent and not available for scheduling, production will be reduced. If breakdowns occur, production quantities will be reduced and sometimes fabricated parts will not be available for assembly. This simulation requires raw materials and fabricated parts are available before assembly operations can be completed. The coordination between the supply-side functions, operations and human resources, is a critical part of this simulation. If operators with the right skills are not employed, than production suffers.

Assembly line balancing is another important decision made by the Operations specialist. Since three products are produced and different skill levels and raw materials are required for each, it is important to schedule the right number of each at a time when it can be used. Cycle time is one of the important measures of operations success. Figure 4 displays an example operations report from the simulation. There are four sections to this report, each displaying an important area of operations responsibilities. Of particular interest are the shop summary and inventory summary. It is in these summaries that the bottlenecks from constraining resources can be found. For example, this report shows no ending inventory for tubing. This is the cause of less than 100% utilization in Framing.

In this paper I have tried to show the usefulness of using a constraints modeling approach to supply-side calculations. The benefits in a total enterprise simulation are a holistic view of manufacturing that incorporates randomness and uncertainty into the student experience.

REFERENCE

Goldratt, Eliyahu M., "The Theory of Constraints", Cronton-on-Hudson, N.Y.: North River Press, 1990.

Figure 4 Sample Operations Report from BusSim® Strategy

Operations Report

Print Define Close

Shop Summary:

	Cutting	Framing	Strapping	OutdoorPak	SchoolPak	SportPak
Production	1,105,757	158,922	271,578	116,124	78,205	34,017
Rejects	7,501	1,078	1,842	787	530	230
Hours Sched	488	488	488	488	488	488
Utilization	100	98	99	100	100	99
Employees	2	3	4	18	10	4
Stations	2	3	4	18	10	4
Prod Rate	1,200	120	150	16	20	22
Pay Rate	13	14	14	11	11	11
Morale	68	66	68	56	53	53
Productivity	95	93	94	83	81	81

Cost Summary:

	Current
Labor	$229,529
Material	$2,520,000
Operating	$997,600
Inventory	$115,511
Qual Control	$50,000
Maintenance	$25,000
Spare Parts	$25,000
Breakdown	$10,000
Overhead	$315,116
Total Cost	$4,287,756

Inventory Summary:

	Beg Inv	Rec/Prod	End Inv	On Order
Fabric	0	1,300	186	1,300
Tubing	0	160,000	0	160,000
Hardware	0	300,000	70,107	300,000
Cut Pieces	0	1,105,757	104,482	
Frames	0	158,922	42,011	
Straps	0	271,578	41,685	

Space Summary:

	Production	Office
Available	1,500	250
Ordered	0	0
Total	45,000	8,000

Team: 1 Industry: Z Quarter: 1