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SALES-FORCE ALLOCATION USING SYSTEM DYNAMICS
An Interactive Qualifying Project Report

submitted to the Faculty

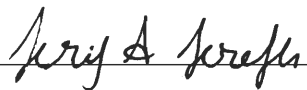
of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

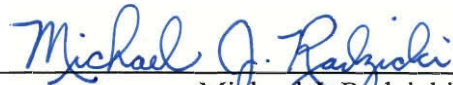
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Approved:



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1. system dynamics
2. sales force

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1. INTRODUCTION

1.1 Introduction

Usually small manufacturing companies can only support and manage one production line. For every different type of product they have to configure their production line to meet their customer's specific needs. Changes in the production line requires time and every minute spent for those changes costs money to the company.

The purchase of new machines for a second production line requires a great amount of capital. Therefore it is too costly to maximize the profit by increasing the number of production lines, but using the available sales force effectively to achieve a high profit is at no extra cost to the company. It requires a knowledge that can be gained by using a model created with system dynamics.

This model of the system knowledge is created with the help of a small manufacturing company producing printed circuit boards (PCB) specifically designed to customer needs. Its production portfolio holds upto 32 types of PCBs and it has only one production line.

This company's sales force activities are used as a base for the model created using system dynamics. The software program "Powersim Constructor" (www.powersim.com) is used to model sales force allocation across potential customers, customers who have received a first quote but not sure to order and inactive customers who might reorder a product.

2 . BACKGROUND

2.1 System Dynamics

2.1.1 History

System dynamics was developed at MIT during the 1950s, primarily by Jay W. Forrester. He brought together ideas from three fields that were then relatively new- control engineering (the concepts of feedback and system self-regulation), information systems, (the nature of information and its role in control systems), and organizational theory (the structure of human organizations and the forms of human decision making). From these basic ideas, Forrester developed a guiding philosophy and a set of representational techniques for simulating complex, nonlinear, multi-loop feedback systems. He originally applied these techniques to problems of industrial firms. The first system dynamics models addresses such general management problems as inventory fluctuations, instability of labor force, and falling market share.

System dynamics field is still dominated by engineers, industrial managers, and physical scientists, all of whom are generally more interested in the application of the method than its theory. The literature of system dynamics contains many more descriptions of models addressed to policy questions than analytical discussions of modeling techniques.

2.1.2 Definition

system['sis-t&m]: 1. a regularly interacting or interdependent group of items forming a unified whole, 2. an organized set of doctrines, ideas, or principles usually intended to explain the arrangement or working of a systematic whole. (Merriam-Webster Dictionary, 1999).

Karnopp and Rosenberg (1975) define system to be an entity separable from the rest of the universe (the environment of the system) by means of a physical or conceptual boundary. But system in itself is also composed of interacting parts. The challenge is the ability to decide what belongs in the system and what represents an external disturbance or command originating from outside of the system. It is the reticulation of a system into its component parts is something that requires skill and art since most systems could be broken up into so many parts that any analysis would be swamped with largely irrelevant detail. (Karnopp and Rosenberg, 1975)

dynamic[dI-'na-mik]: a pattern or process of change, growth, or activity. {alive, functioning, live, operative, running, working} (Merriam-Webster Dictionary, 1999)

Two issues in real world make a main difference between static and dynamic systems. One of which is time that is considered as the forth dimension by many scientists and the other one is the human mind which is effected also by time but not vice versa.

No system (or generally a being) can operate in a truly static or steady state.(Karnopp and Rosenberg, 1975) All business firms, economies and social organizations show dynamic behavior. That is, as time passes, the variables by which we measure their condition fluctuate noticeably.(Coyle, 1977) Systems of all kinds can exhibit counter-intuitive behavior when considered statically. A change in a system or a control policy may appear beneficial in the short run based on static considerations, but may have long-run repercussions opposite to the initial effect and thus cause catastrophic termination of the system.

The word "dynamic" also defines the unique difference between decision systems in traditional modeling and system dynamics. Most of the traditional systems analyzing procedures and policies retrieve their information and data from written documentation, surveys or historical data to build their structure for solving problems. These resources are static parameters of a system. The dynamic part is the humans cognitive system that supports learning, reasoning, and problem-solving.

System dynamicists would regard a series of conversations with mothers about their children to be as useful a source of information as a twenty-year time series on fertility data.(Randers, 1980) The reason behind this is that mental information about human experience records the history of decisions, the policy governing decisions, the necessity of with incomplete information, the structure that connects real activities to information streams, and a wealth of insight into why people act as they do. The more

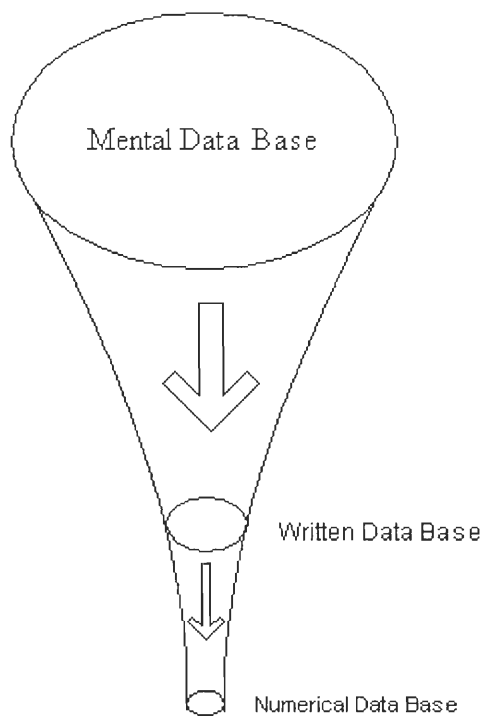


Figure 1. Mental data base and decreasing content of written and numerical data bases.

permanent written literature tends to withdraw to a broader perspective from which the working reason for decisions are lost. As one shifts from written descriptive information into numerical information, another tremendous loss occurs in the relevance to dynamic behavior.(see Figure 1.) For example, accounting data and economic time series are numerical summaries of the consequences of decision-making but have almost no contact with the policies that guided the decisions that produced the numerical results.(Legasto, Forrester and Lyneis, 1980)

For simple systems, the human mind is capable to gather and store the necessary data, make connections between them. Processing these according the conditions and policies governing the flow of data (money, people, products, etc.) in the system and come up with the best suitable and effective way of running the system. But if it advances

to complex cases, the human mind is incapable to make all the interconnections accurately and proceed with a decision.

2.1.3 Classification for casual structures

There are two classes of system: open-loop and closed-loop. In the open-loop system the output arises from the input but has no effect on the input. The distinguishing feature of the closed system is a feedback path of information, choice and action, connecting the output to the input. This creates a closed chain of cause and effect consisting of the physical flow of goods and the associated feedback path of information.

The important thing about feedback loops is that they are the cause of dynamic behavior. An open loop system can have dynamics arising from its response to external changes. The dynamics of a closed system on the other hand, are created by its attempts to control itself in the face of external variations.

The structure of a closed-loop system includes the way in which its flows of materials and/or information are connected and the way in which these flows are modified or transformed by delays and decision rules embedded in the loop. Obviously the key to improving the dynamics of a closed system will lie in changing its structure, either by altering the connectedness of its flows and/or changing its decision rules. It is practically unknown for any system to be anything other than closed-loop.(Coyle, 1977)

2.1.4 Elements

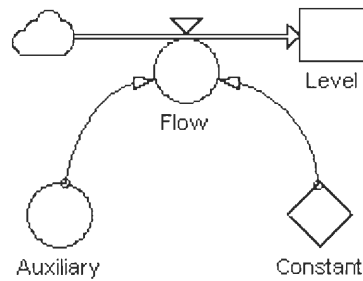


Figure 2. Elements of a basic system dynamics model.

Levels are used to represent the state variables of a system. Levels accumulate connected flows.

Flows represent the idea of quantities being transported between level variables. Levels are changed by adding the values of inflows and subtracting the values of outflows from their current values. Since flows are added to or subtracted from levels, flows must have the same unit of measure as the connected levels. The value of a flow is therefore defined as the associated rate variable multiplied by the time step. When referring to the time-relative values of flows into or out of levels, the term flow rate (or simply rate) is used commonly. Rate will always have a unit of measure relative to time. E.g., if the time unit is "Week", and a rate is controlling a level with "Products", the rate's unit should be "Products/Week".

Auxiliaries can be functions of levels, rates, or other auxiliaries. These functions help clarify the definition of rates and their ultimate dependence on the system levels.

Constant is a variable type used to hold constant values. Typically used as parameters for tuning a model and receiving user input during a simulation run.

2.2 Sales Management

Sales management can be thought of as consisting of three processes: formulation of a sales program; development of systems, policies, and procedures to implement the sales program; and actual implementation at the field sales management level. (Shapiro, p.5)

2.2.1 Sections of Formulation

Major topics in the formulation of the sales program are: personal selling in the marketing mix; deployment; account management; costs and budgets. The first part of sales program formulation is to assign to the personal selling effort those tasks which it can perform more efficiently and more effectively. Next comes the decision involving “sell what to whom?”. This is deployment or the assignment of the selling effort to particular customers and products. Deployment can be a key to efficient, effective use of personal selling. The third major phase of sales program formulation involves account management. It concerns the interaction between the firm and its prospective and current accounts. The final major aspect of the sales program is cost which is primarily dependent on the size of the sales-force. The issue of costs and budgets is at the base of all areas of sales management. In allocating funds to personal selling in the marketing mix the crucial question is marginal return versus marginal cost or investment. (Shapiro, p.13-15)

2.2.2 Proper Allocation of Effort among Customers

The allocation of sales effort to present and potential customers is a major determinant of territory decisions. The following allocation problems are usually present: dividing available time between present and potential customers, determining the proper amount of time per call for various customer categories (call length), and determining the proper number of calls per time period for those same customer categories (call frequency). Whether effort is allocated properly depends on how well its results contribute to the firm's goals.

To make allocation decisions, management must determine how customers and prospects respond to personal selling effort. This response can be measured in terms of profit, sales volume, or whatever other goals are being sought.(Wotruba, p.157)

3. METHODOLOGY

3.1 Sales-force

Sales force, shown in Figure 3, is the number of sales people working in the company. Depending on the company's size, products, or sales strategy this number can change. By demand an additional sales person will be hired and trained to learn company's sales policies and then be considered as a sales effecting individual. Sales training programs vary in formality, length and content. Hiring and training sales-people who sell printed circuit boards is much more extensive than with those who sell standardized consumer goods.

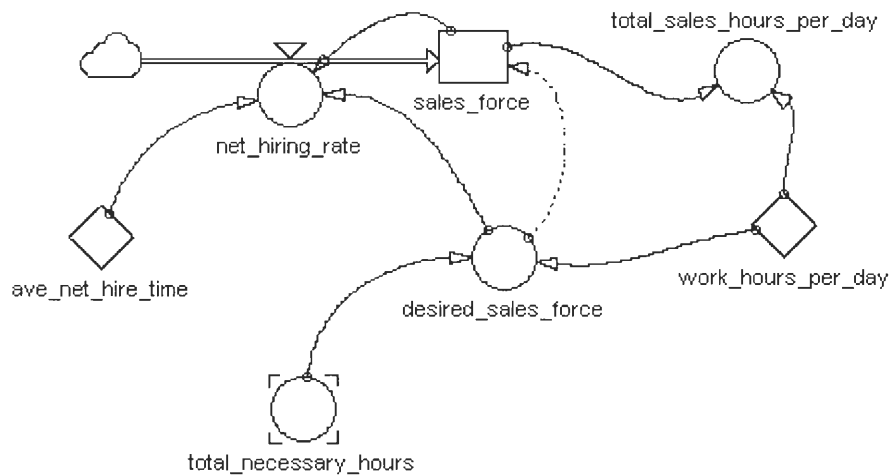


Figure 3. Sales-force model (see Appendix A for equations)

The initial value of the sales force is set equal to the desired sales force value. As the total necessary hours increases the desired sales force increases as well. To keep the sales force value equal to the value of the desired sales force the company will hire new employees. As mentioned earlier this process will take time as sales people for printed circuit boards may not be available the next day of the demand. After some time delay

sales force will reach the desired value. Assuming that all sales people are working full-time, 8 hours a day, the total sales hours per day can be calculated by multiplying the number of sales people and the work hours per day.

3.2 Customer stages

Sales force is considered to interact with customers at three stages in the selling process: (1) prospecting for new customers, (2) quoting for customers aware of the company present, and (3) contacting former customers.

3.2.1 Prospective

Prospects (potential customers) are companies that are likely to buy your product. Before gaining prospect status, these companies are called leads or suspects. (Allen et. al, p.110) Mailing lists and trade shows are couple of many ways to attract these prospects.

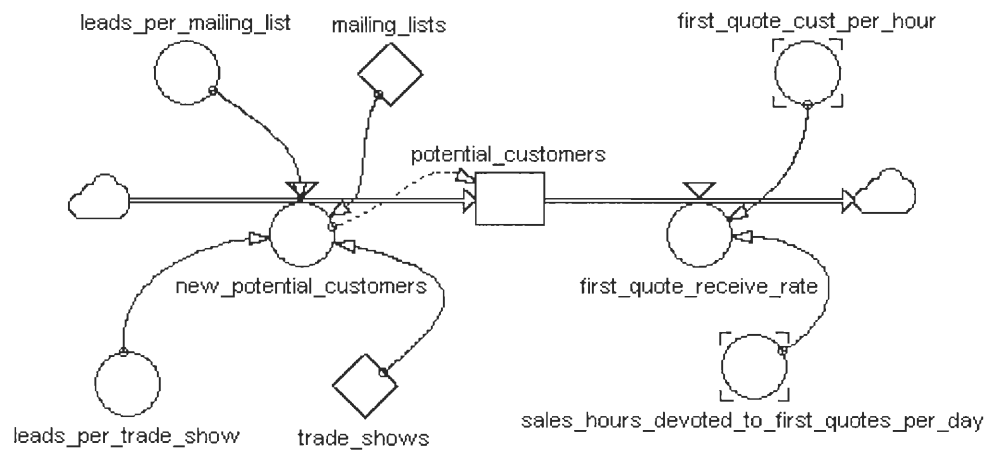
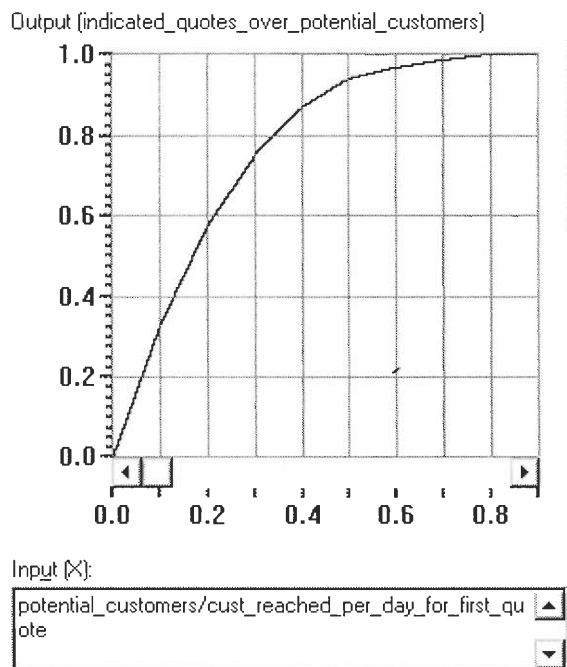


Figure 4. Potential customer model (see Appendix A for equations)



As seen in Figure 4 the number of potential customers increases with the inflow of new potential customers contacted through trade shows and mailing lists.

Figure 5. Efficiency fraction

Sales force effort allocated to potential customers, as shown in Figure 6, is the driving force to decrease the number of potential customers who are unaware of any quotes.

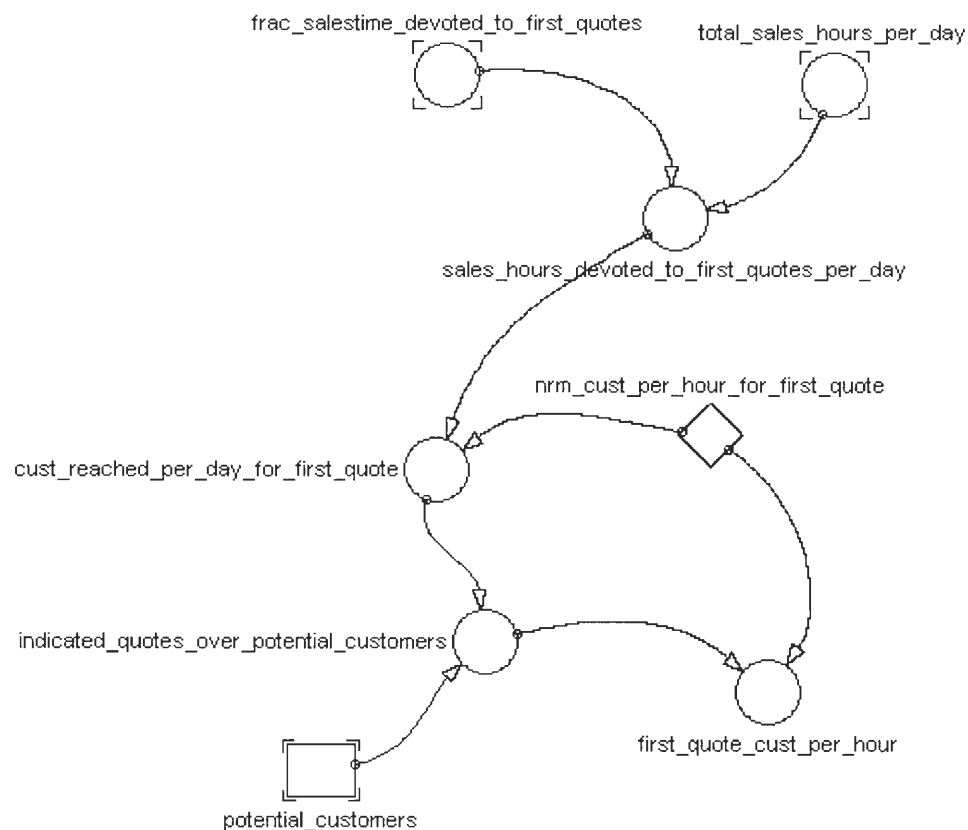


Figure 6. Sales force efforts for potential customers (see Appendix A for equations)

A fraction of the total sales hours per day is devoted to potential customers. The normal number of customers that can be reached within one hour is multiplied with the devoted sales force hours per day to find how many customers can be reached per day. If this number of customers is greater than the number of potential customers, the efficiency of the allocated sales force is adjusted as seen in Figure 5. As the number of customers that can be reached in one day for first quote approaches the actual existing number of potential customers the first quote customer per hour. So the number of customers who get the first quote per day is found by multiplying the sales hours devoted to first quotes per day with the adjusted value of first quote customers per hour as shown in Figure 4.

After the potential customers receive the first quote they either buy a double sided PCB, or a multi layered PCB or they prefer not to order. (Figure 7.)

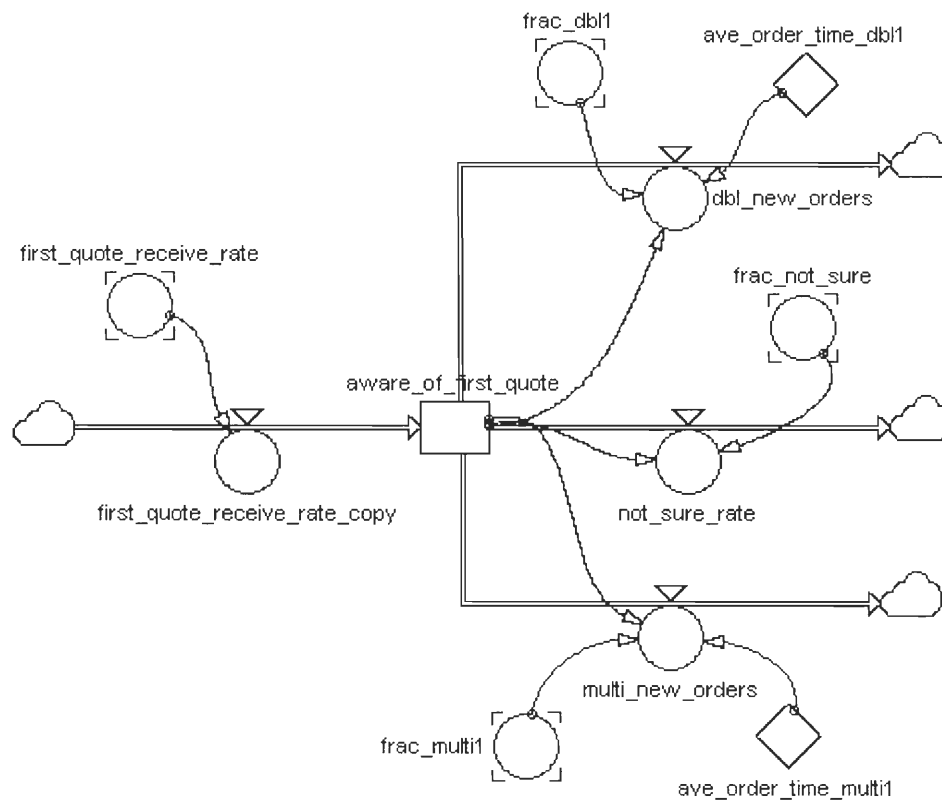


Figure 7. Customer distribution after the first quote (see Appendix A for equations)

At this level the decision made by the customers is controlled with the model as shown in Figure 8. Customers will choose one or the other product or not to order by comparing our price with our competitor's price. This allows the user of the model to change the price of units for various sectors of customers during simulation and see the effects of those policy changes.

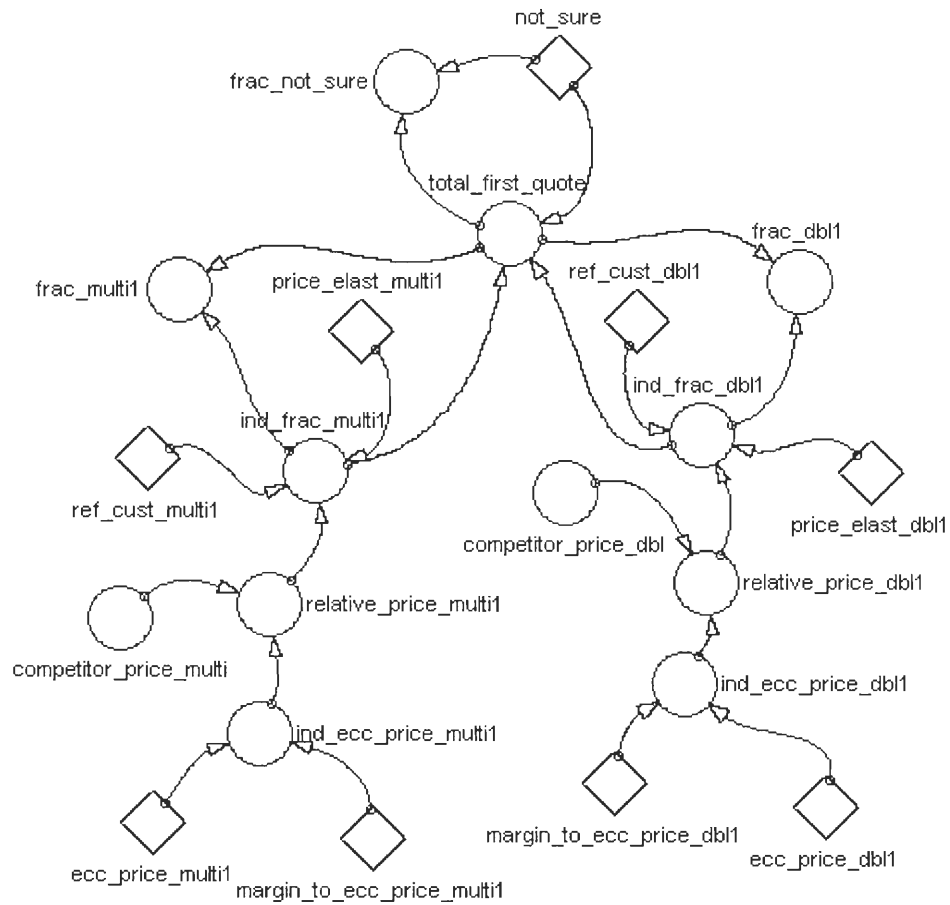


Figure 8. Distribution model first quote aware customers (see Appendix A for equations)

To make sure all the fractions in the distribution model after the first quote add up to one each one is divided to the sum of all. This methodology is used several times in the model, but is only explained here once.

3.2.2 Aware customers

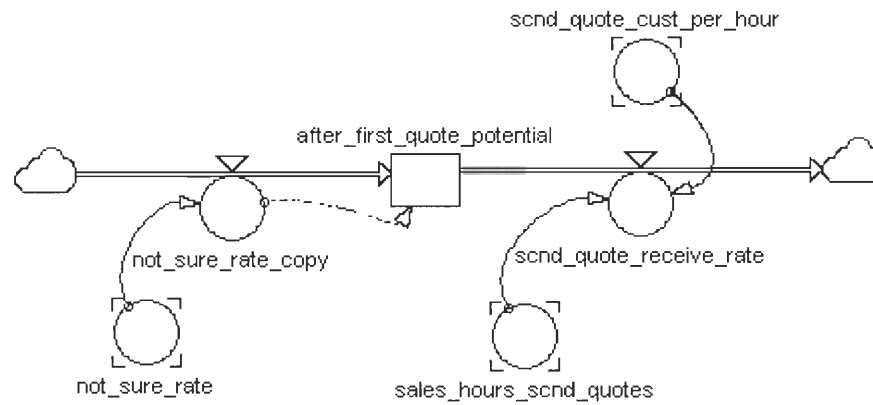


Figure 9. After first quote potential (aware) customers model (see Appendix A for equations)

Second category of customers are aware of the company and it's products, already received a quote from sales force, but are not sure to make a purchase. (Figure 9)

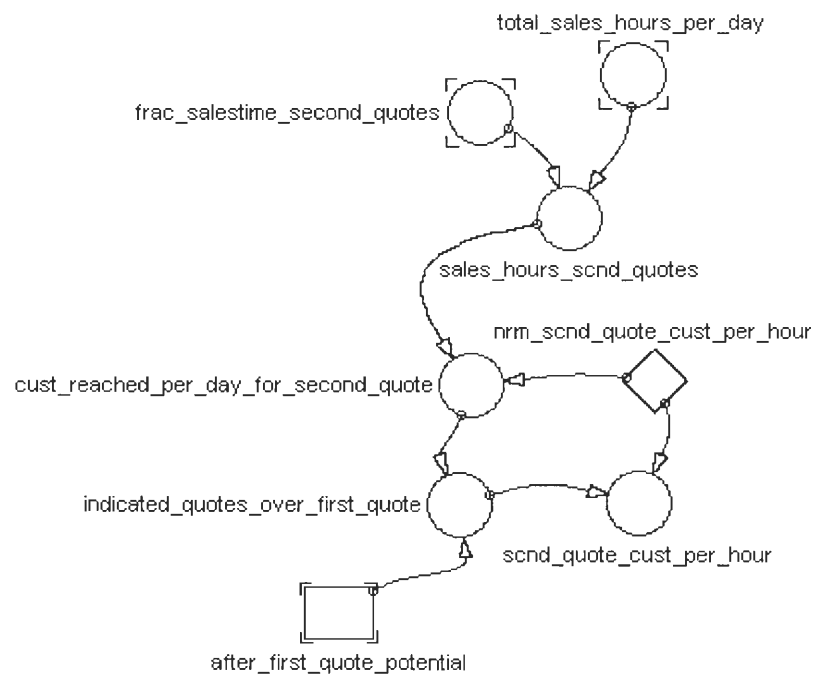


Figure 10. Sales force effort for a second quote (see Appendix A for equations)

Sales force's goal is to convince them to order by giving them a second quote. (Figure 10)

Using the distribution model created for second quote customers (Figure 11) the second quote can be set to be something different than the first quote which could be used to attract customers who found the first quote to be expensive. The methodology to make sure that the fractions add up to one is the same as explained in the previous section of the report.

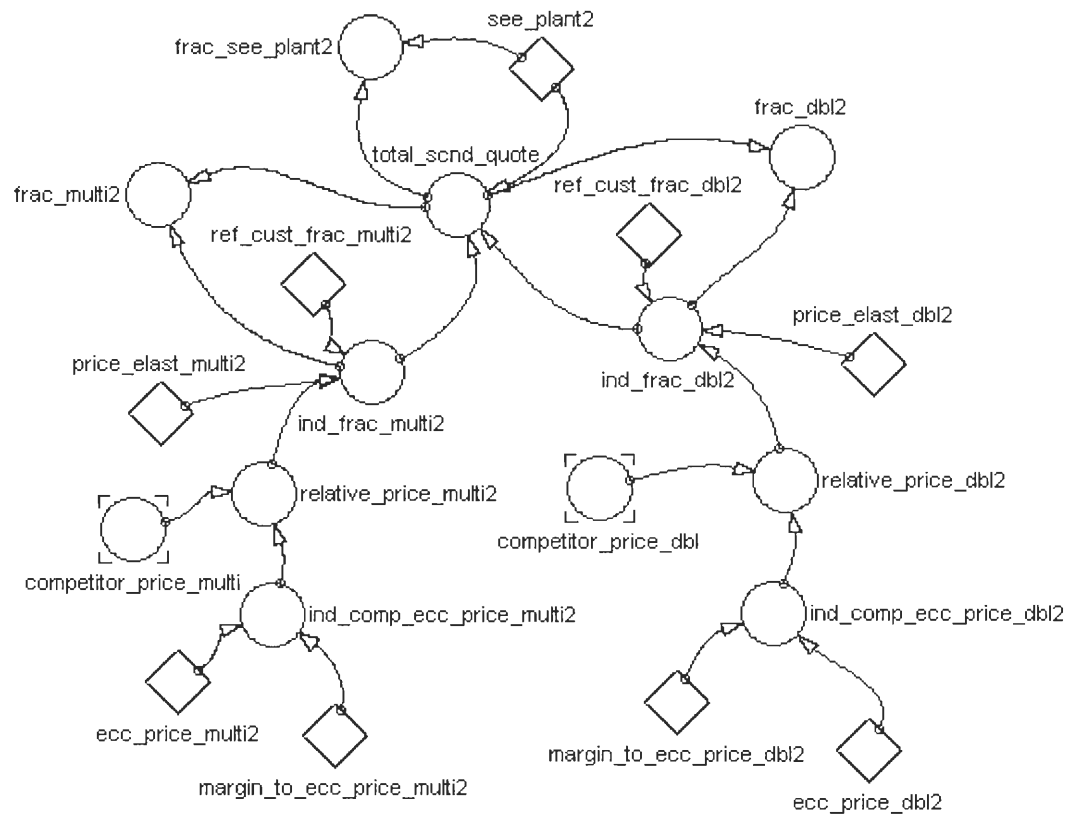


Figure 11. Distribution model second quote aware customers (see Appendix A for equations)

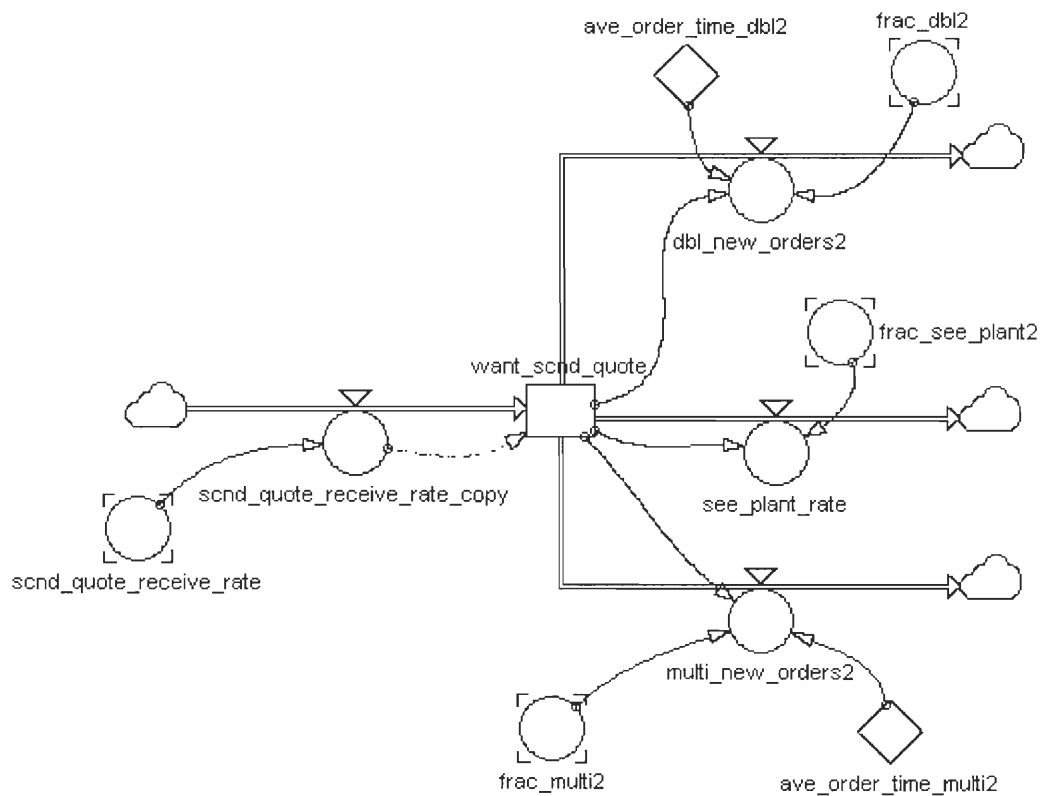


Figure 12. Customer distribution after the second quote (see Appendix A for equations)

If, after receiving a second quote (Figure 12), customers are still not sure they usually ask for a plant visit. If the production facility satisfies these customer and the quote is reasonable compared to the competitor's price they order a double or a multi.

For all other cases the customers leave the model at this stage. (Figure 13)

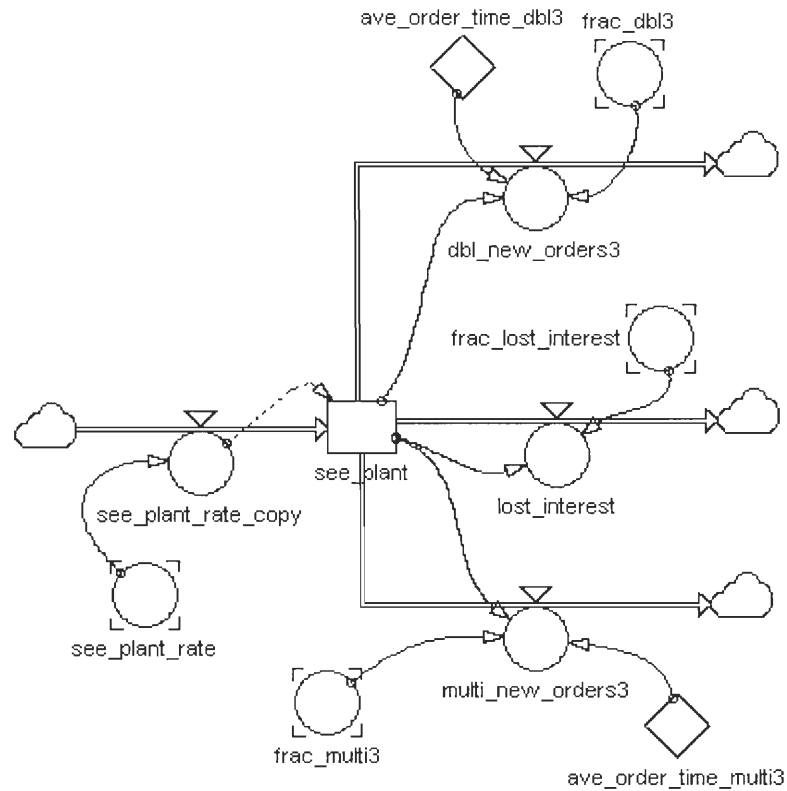


Figure 13. Customer distribution after the plant visit (see Appendix A for equations)

3.2.3 Inactive former customers

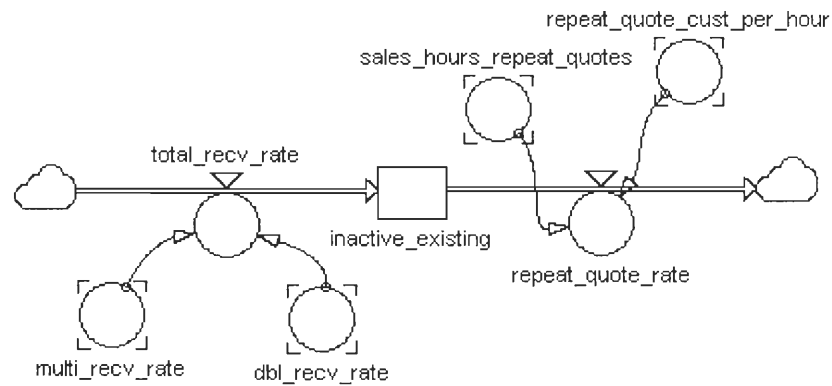


Figure 14. Inactive existing customers model (see Appendix A for equations)

Inactive former customers are those customers who have made a purchase once, but do not have a current order. These customers are approached by the sales force that

has the same structure as the other sales force sections, but with the only difference being the allocated time.

New orders received from this customer sector are usually repeat orders. Since the needs of regular customers are well known, the process of fulfilling their order is faster than in the case of a prospect. That makes the average order times shown in Figure 15 for a repeat order smaller.

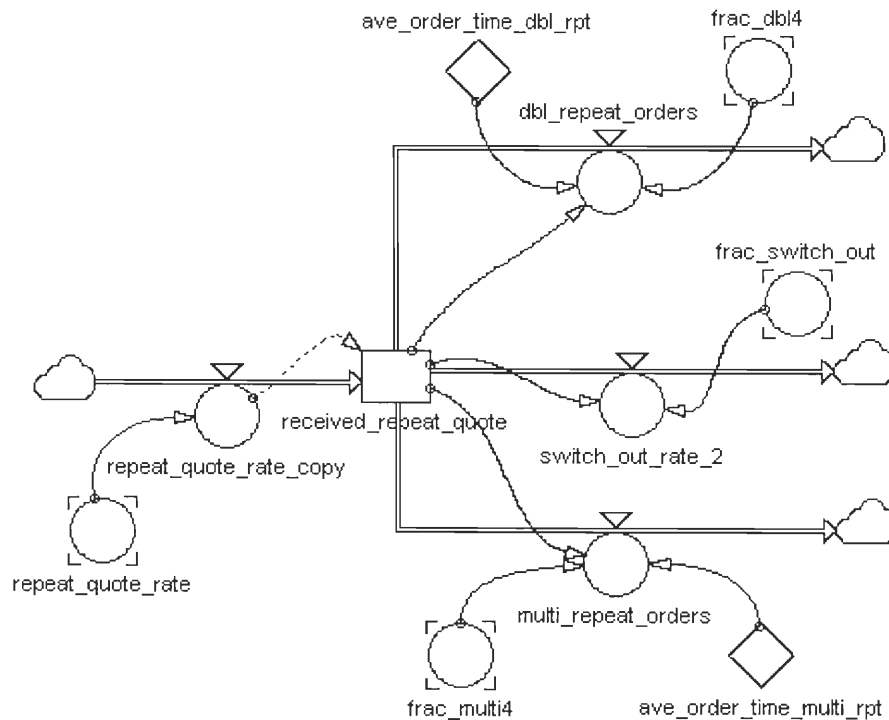


Figure 15. Customer distribution after the repeat quote (see Appendix A for equations)

3.3 Orders

When a customer makes an order for a double or a multi this accumulates in the double/multi level as shown in Figure 16 and Figure 17. Orders made after the first and second quote, after the plant visit and the repeat orders are inflows to double and multi levels. Customers whose orders are met flow out of the double and multi level depending on the production speed (average time to receive double/multi) and accumulate in the inactive existing customer level explained earlier in the report.

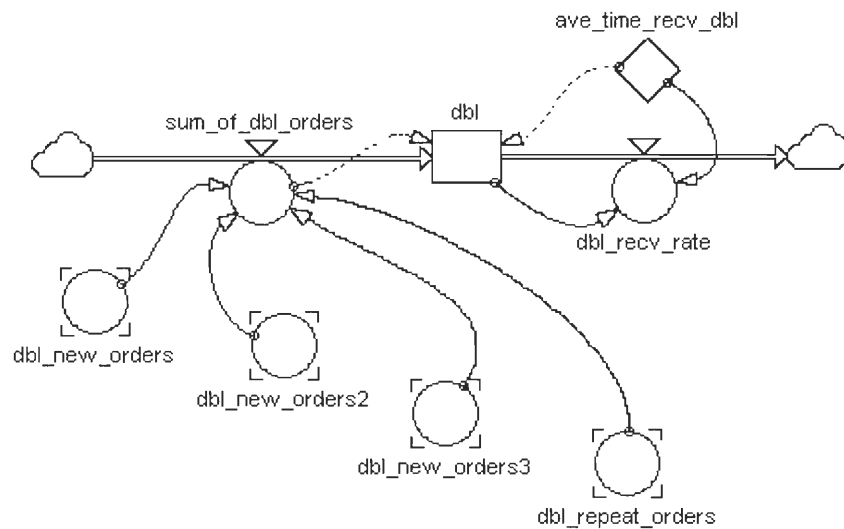


Figure 16. Double orders (see Appendix A for equations)

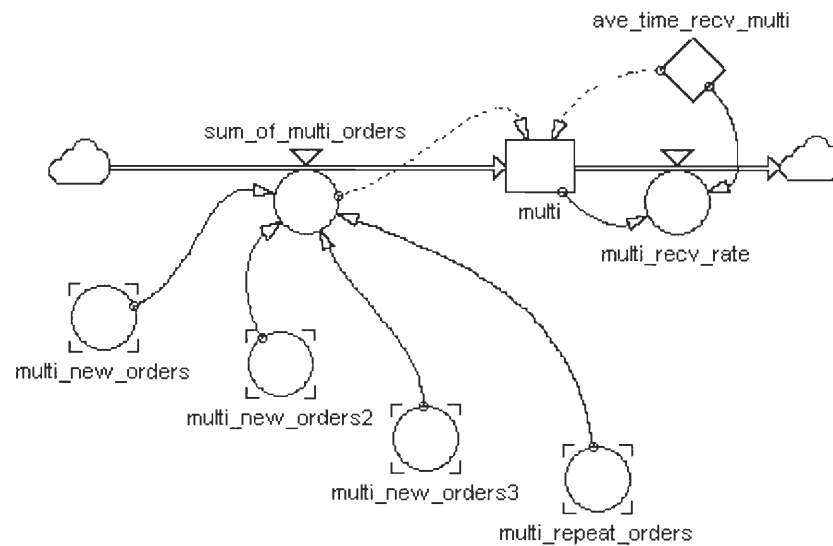


Figure 17. Multi orders (see Appendix A for equations)

3.4 Allocation

Finally the model needs to be flexible enough to make changes to the time allocated for each sector of customers. As shown in Figure 18 each fraction of the sales effort to each sector is effected by the number of customers existing in that sector and the normal number of customers that can be reached in one hour for that sector.

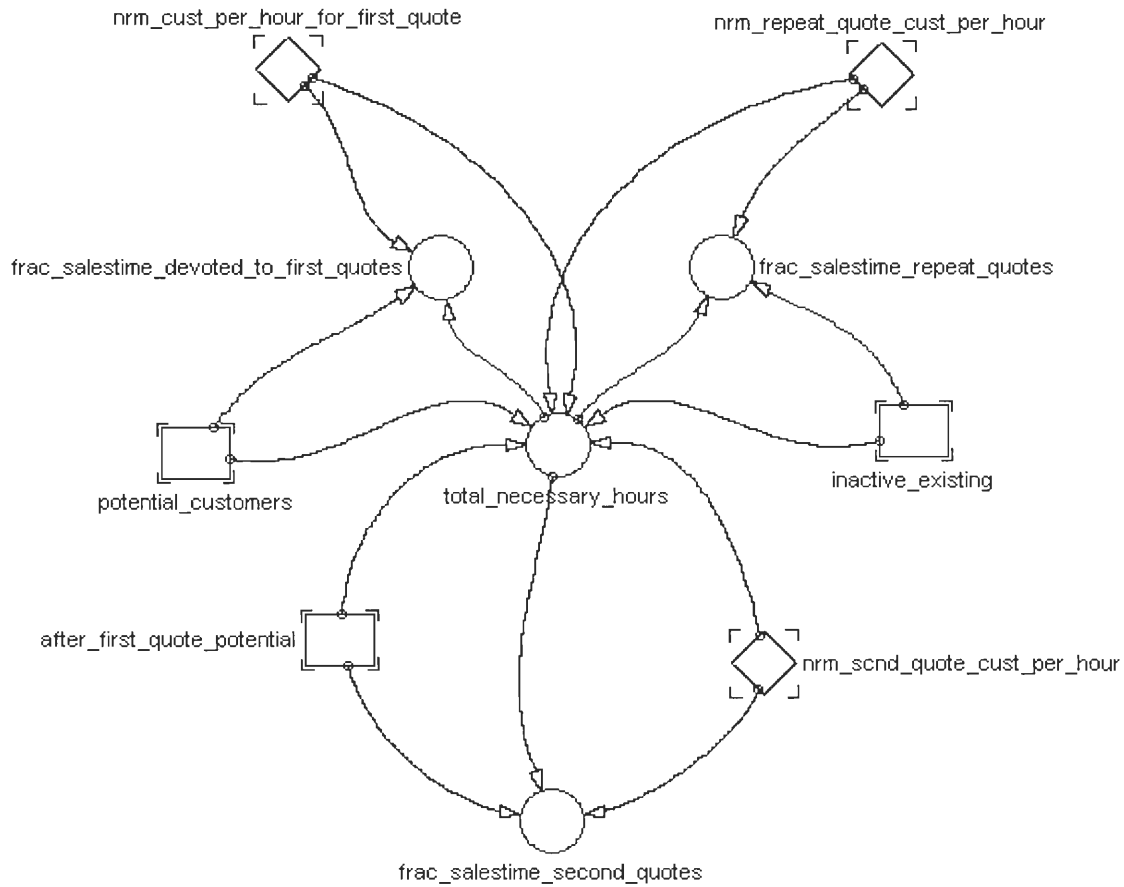


Figure 18. Sales force allocation (see Appendix A for equations)

This way, for example, the sales people of the company will shift their effort from potential customers to inactive existing customers as the number of customers with fulfilled orders increases.

The total necessary hours calculated here is also used to adjust the number of sales people the company needs to operate effectively. This section of the model is also designed so that the fractions always add up to one.

4. RESULTS AND DISCUSSIONS

4.1 Sales force Model in Equilibrium

Before any simulation can be run on a system dynamics model it is always recommended to bring the model into an equilibrium. This allows the user to see the effects of any changes made to the model clearly. Without reaching the equilibrium there is usually noise in the graph of levels that will hinder the user to distinguish what the response of the system is.

To bring the model into equilibrium the inflows to and outflows from each level need to be the same. The graph shown in Appendix B shows clearly that the system reaches an equilibrium for all levels.

4.2 Response to changes

The system dynamics model is run everytime after making the following changes:

Change	Response	Graph
Increase in average net hire time	Damped oscillations due to the delay introduced	Appendix C
Increase frequency of trade shows	Potential customers and customers received repeat quote increased	Appendix D
Decrease double&multi price for second quote	Orders after second quote increased Customers visiting plant decreased	Appendix E
Increase in normal repeat customers reached per hour	Total hours necessary and number of sales people decreased	Appendix F

5. RECOMMENDATIONS AND CONCLUSIONS

The sales force model is created to simulate the sales dynamics of a small company. This model can be combined with a model simulating the production system. Such a model would allow its users to see how the sales force allocation effects the production schedule.

6 . REFERENCES

- Allen, Robert Y.; Spohn, Robert F.; Wilson, I. Herbert; Selling dynamics, McGraw-Hill, Inc., 1984
- Coyle, R. G.; Management system dynamics, John Wiley & Sons Inc., 1977.
- Forrester, Jay W.; Industrial dynamics, The MIT Press, 1961.
- Goodman, Michael R.; Study notes in system dynamics, Wright-Allen Press, 1974.
- Johnson, Eugene M.; Kurtz, David L.; Scheuing, Eberhard E.; Sales management; concepts, practices, and cases., McGraw-Hill, Inc., 1986.
- Karnopp, Dean; Rosenberg, Ronald; System Dynamics: A Unified Approach, John Wiley & Sons, Inc., 1975.
- Kotler, Philip; Marketing management; analysis, planning and control, Prentice-Hall, Inc., 1967
- Legasto, Augusto A.; Forrester, Jay W.; Lyneis, James M., System dynamics, North-Holland Publishing Company, 1980
- Randers, Jorgen; Elements of the system dynamics method, The MIT Press, 1980.
- Roberts, Nancy; Andersen, David; Deal, Ralph; Garet, Michael; Shaffer, William; Introduction to computer simulation: a system dynamics approach, Addison-Wesley Publishing Company, 1983.
- Shapiro, Benson P.; Sales program management: formulation and implementation, McGraw-Hill Inc., 1977.
- Wotruba, Thomas R.; Sales management; planning, accomplishment, and evaluation, Holt, Rinehart and Winston, Inc., 1971

APPENDIX A.

EQUATIONS OF THE COMPLETE SALES FORCE MODEL

```

level  after_first_quote_potential
level  aware_of_first_quote
level  dbl
level  inactive_existing
level  multi
level  potential_customers
level  received_repeat_quote
level  sales_force
level  see_plant
level  want_scnd_quote
aux    dbl_new_orders = (aware_of_first_quote/ave_order_time_dbl1)*frac_dbl1
aux    dbl_new_orders2 = (want_scnd_quote/ave_order_time_dbl2)*frac_dbl2
aux    dbl_new_orders3 = (see_plant/ave_order_time_dbl3)*frac_dbl3
aux    dbl_rcv_rate = dbl/ave_time_rcv_dbl
aux    dbl_repeat_orders = (received_repeat_quote/ave_order_time_dbl_rpt)*frac_dbl4
aux    first_quote_receive_rate =
first_quote_cust_per_hour*sales_hours_devoted_to_first_quotes_per_day
aux    first_quote_receive_rate_copy = first_quote_receive_rate
aux    lost_interest = see_plant*frac_lost_interest
aux    multi_new_orders = (aware_of_first_quote/ave_order_time_multi1)*frac_multi1
aux    multi_new_orders2 = (want_scnd_quote/ave_order_time_multi2)*frac_multi2
aux    multi_new_orders3 = (see_plant/ave_order_time_multi3)*frac_multi3
aux    multi_rcv_rate = multi/ave_time_rcv_multi
aux    multi_repeat_orders = (received_repeat_quote/ave_order_time_multi_rpt)*frac_multi4
aux    net_hiring_rate = (desired_sales_force-sales_force)/ave_net_hire_time
aux    new_potential_customers =
(mailing_lists*leads_per_mailing_list)+(trade_shows*leads_per_trade_show)
aux    not_sure_rate = aware_of_first_quote*frac_not_sure
aux    not_sure_rate_copy = not_sure_rate
aux    repeat_quote_rate = repeat_quote_cust_per_hour*sales_hours_repeat_quotes
aux    repeat_quote_rate_copy = repeat_quote_rate
aux    scnd_quote_receive_rate = sales_hours_scnd_quotes*scnd_quote_cust_per_hour
aux    scnd_quote_receive_rate_copy = scnd_quote_receive_rate
aux    see_plant_rate = want_scnd_quote*frac_see_plant2
aux    see_plant_rate_copy = see_plant_rate
aux    sum_of_dbl_orders = dbl_new_orders+dbl_new_orders2+dbl_new_orders3+dbl_repeat_orders
aux    sum_of_multi_orders =
multi_new_orders+multi_new_orders2+multi_new_orders3+multi_repeat_orders
aux    switch_out_rate_2 = received_repeat_quote*frac_switch_out
aux    total_rcv_rate = dbl_rcv_rate+multi_rcv_rate
aux    competitor_price_dbl = 150 + RAMP(0,0)
aux    competitor_price_multi = 150 + RAMP(0,0)
aux    cust_reached_per_day_for_first_quote =
sales_hours_devoted_to_first_quotes_per_day*nrm_cust_per_hour_for_first_quote
aux    cust_reached_per_day_for_second_quote =
sales_hours_scnd_quotes*nrm_scnd_quote_cust_per_hour
aux    desired_sales_force = total_necessary_hours/work_hours_per_day
aux    first_quote_cust_per_hour =
nrm_cust_per_hour_for_first_quote*indicated_quotes_over_potential_customers
aux    frac_dbl1 = ind_frac_dbl1/total_first_quote
aux    frac_dbl2 = ind_frac_dbl2/total_scnd_quote
aux    frac_dbl3 = ind_frac_dbl3/total_see_plant
aux    frac_dbl4 = ind_frac_dbl4/total_repeat_quote
aux    frac_lost_interest = lose_interest/total_see_plant

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aux      frac_multi1 = ind_frac_multi1/total_first_quote
aux      frac_multi2 = ind_frac_multi2/total_scnd_quote
aux      frac_multi3 = ind_frac_multi3/total_see_plant
aux      frac_multi4 = ind_frac_multi4/total_repeat_quote
aux      frac_not_sure = not_sure/total_first_quote
aux      frac_salestime_devoted_to_first_quotes =
potential_customers/(nrm_cust_per_hour_for_first_quote*total_necessary_hours)
aux      frac_salestime_repeat_quotes =
inactive_existing/(total_necessary_hours*nrm_repeat_quote_cust_per_hour)
aux      frac_salestime_second_quotes =
after_first_quote_potential/(total_necessary_hours*nrm_scnd_quote_cust_per_hour)
aux      frac_see_plant2 = see_plant2/total_scnd_quote
aux      frac_switch_out = switch_out/total_repeat_quote
aux      ind_comp_ecc_price_dbl2 = (1+margin_to_ecc_price_dbl2)*ecc_price_dbl2
aux      ind_comp_ecc_price_dbl3 = (1+margin_to_ecc_price_dbl3)*ecc_price_dbl3
aux      ind_comp_ecc_price_dbl4 = (1+margin_to_ecc_price_dbl4)*ecc_price_dbl4
aux      ind_comp_ecc_price_multi2 = (1+margin_to_ecc_price_multi2)*ecc_price_multi2
aux      ind_comp_ecc_price_multi3 = (1+margin_to_ecc_price_multi3)*ecc_price_multi3
aux      ind_comp_ecc_price_multi4 = (1+margin_to_ecc_price_multi4)*ecc_price_multi4
aux      ind_ecc_price_dbl1 = (1+margin_to_ecc_price_dbl1)*ecc_price_dbl1
aux      ind_ecc_price_multi1 = (1+margin_to_ecc_price_multi1)*ecc_price_multi1
aux      ind_frac_dbl1 = ref_cust_dbl1*(relative_price_dbl1^price_elast_dbl1)
aux      ind_frac_dbl2 = ref_cust_frac_dbl2*(relative_price_dbl2^price_elast_dbl2)
aux      ind_frac_dbl3 = ref_cust_frac_dbl3*(relative_price_dbl3^price_elast_dbl3)
aux      ind_frac_dbl4 = ref_cust_frac_dbl4*(relative_price_dbl4^price_elast_dbl4)
aux      ind_frac_multi1 = ref_cust_multi1*(relative_price_multi1^price_elast_multi1)
aux      ind_frac_multi2 = ref_cust_frac_multi2*(relative_price_multi2^price_elast_multi2)
aux      ind_frac_multi3 = ref_cust_frac_multi3*(relative_price_multi3^price_elast_multi3)
aux      ind_frac_multi4 = ref_cust_frac_multi4*(relative_price_multi4^price_elast_multi4)
aux      ind_repeat_quote_rate = nrm_repeat_quote_cust_per_hour*sales_hours_repeat_quotes
aux      indicated_quotes_over_first_quote =
GRAPH(after_first_quote_potential/cust_reached_per_day_for_second_quote,0,0.1,[0,0.415,0.66,0.79,0.88
,0.925,0.95,0.975,0.985,0.995,1"Min:0;Max:1;Zoom"])
aux      indicated_quotes_over_potential_customers =
GRAPH(potential_customers/cust_reached_per_day_for_first_quote,0,0.1,[0,0.33,0.58,0.75,0.87,0.94,0.97,
0.99,1,1,1"Min:0;Max:1"])
aux      leads_per_mailing_list = 100+STEP(0,50)
aux      leads_per_trade_show = 5+STEP(0,50)
aux      relative_price_dbl1 = ind_ecc_price_dbl1/competitor_price_dbl
aux      relative_price_dbl2 = ind_comp_ecc_price_dbl2/competitor_price_dbl
aux      relative_price_dbl3 = ind_comp_ecc_price_dbl3/competitor_price_dbl
aux      relative_price_dbl4 = ind_comp_ecc_price_dbl4/competitor_price_dbl
aux      relative_price_multi1 = ind_ecc_price_multi1/competitor_price_multi
aux      relative_price_multi2 = ind_comp_ecc_price_multi2/competitor_price_multi
aux      relative_price_multi3 = ind_comp_ecc_price_multi3/competitor_price_multi
aux      relative_price_multi4 = ind_comp_ecc_price_multi4/competitor_price_multi
aux      repeat_cov =
GRAPH(inactive_existing/ind_repeat_quote_rate,0,0.1,[0,0.415,0.66,0.79,0.88,0.925,0.95,0.975,0.985,0.99
5,1"Min:0;Max:1"])
aux      repeat_quote_cust_per_hour = repeat_cov*nrm_repeat_quote_cust_per_hour
aux      sales_hours_devoted_to_first_quotes_per_day =
total_sales_hours_per_day*frac_salestime_devoted_to_first_quotes
aux      sales_hours_repeat_quotes = frac_salestime_repeat_quotes*total_sales_hours_per_day
aux      sales_hours_scnd_quotes = total_sales_hours_per_day*frac_salestime_second_quotes
aux      scnd_quote_cust_per_hour = indicated_quotes_over_first_quote*nrm_scnd_quote_cust_per_hour
aux      total_first_quote = ind_frac_dbl1+ind_frac_multi1+not_sure
aux      total_necessary_hours =
after_first_quote_potential/nrm_scnd_quote_cust_per_hour+potential_customers/nrm_cust_per_hour_for_f
irst_quote+inactive_existing/nrm_repeat_quote_cust_per_hour

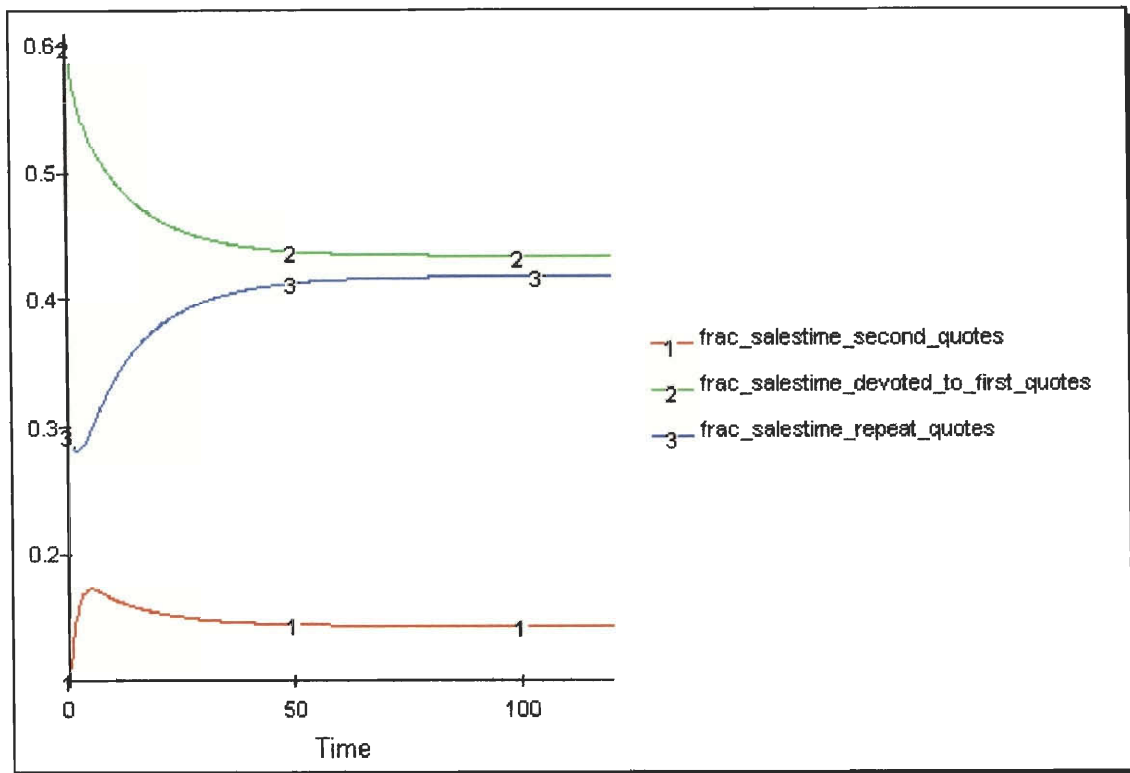
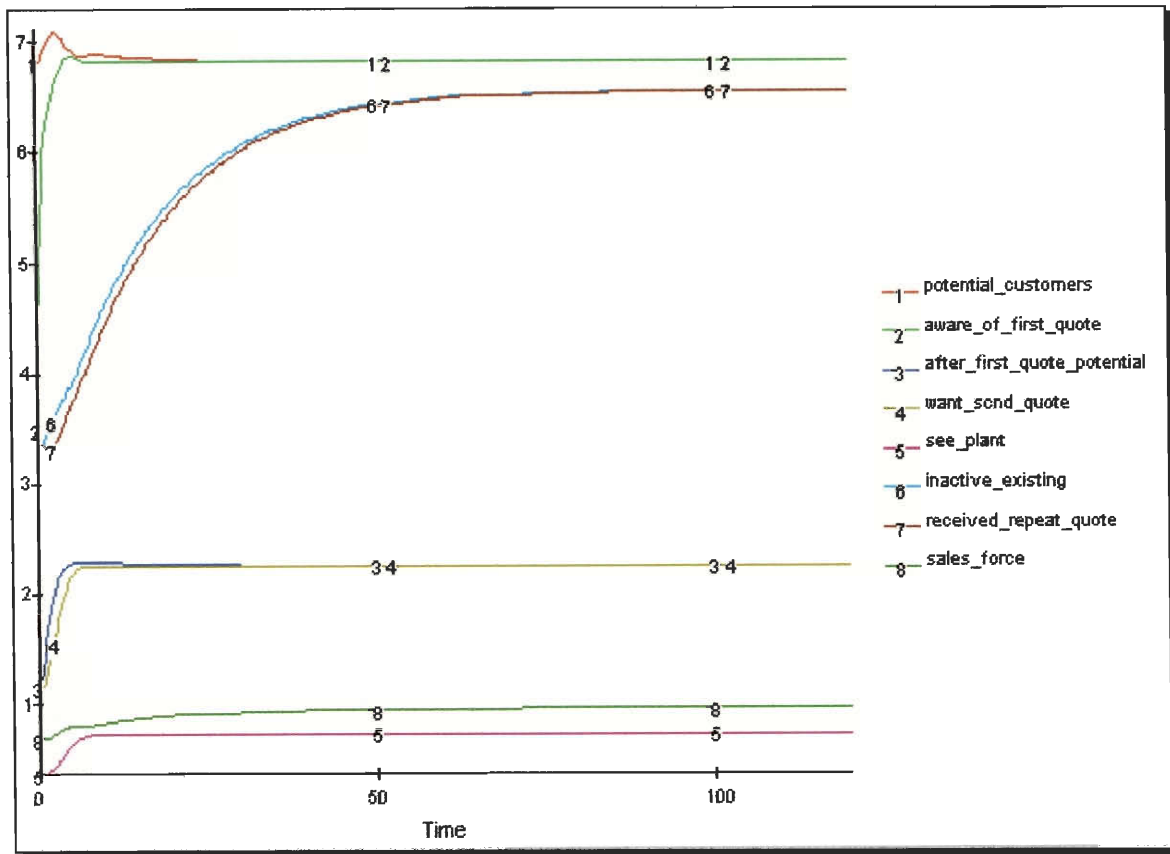
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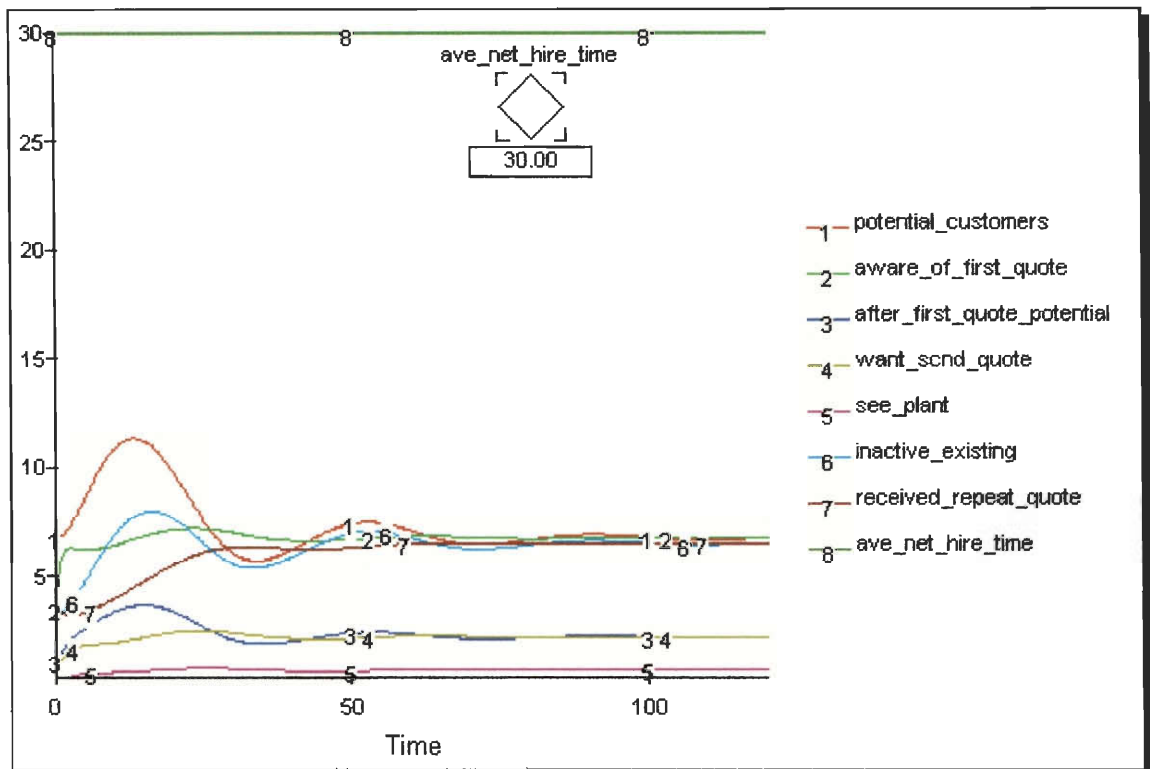
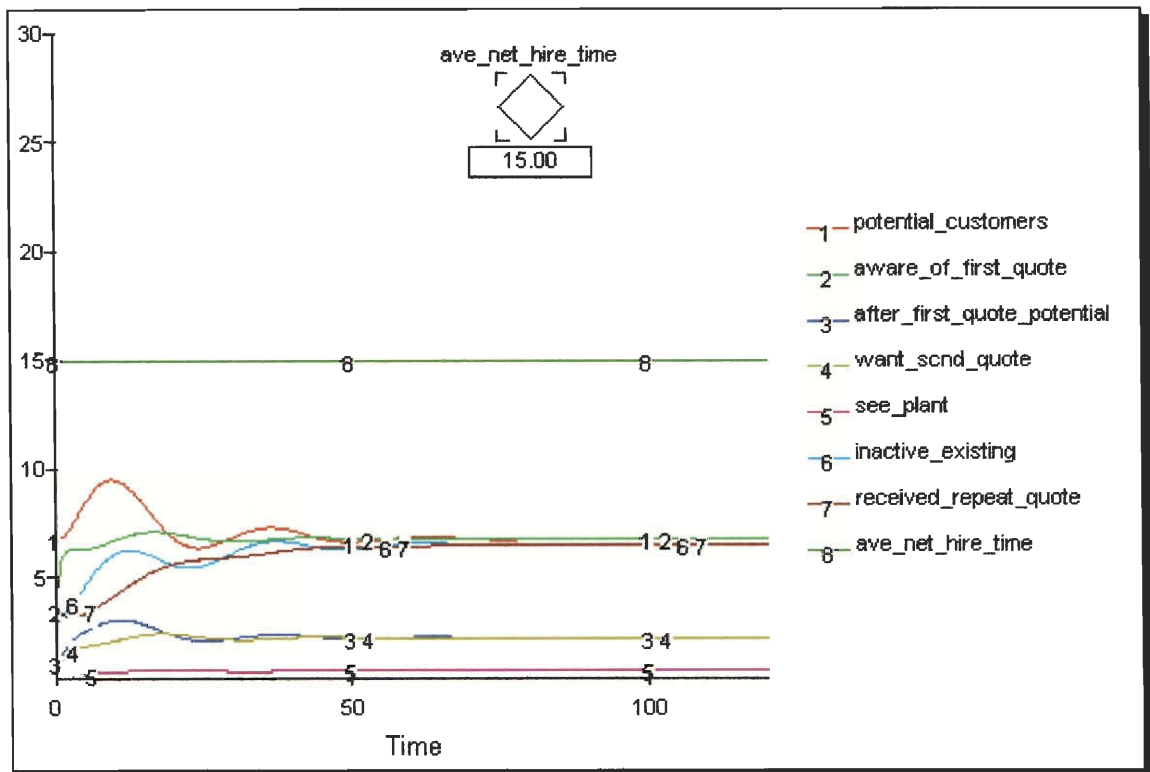
aux    total_repeat_quote = switch_out+ind_frac_dbl4+ind_frac_multi4
aux    total_sales_hours_per_day = sales_force*work_hours_per_day
aux    total_scnd_quote = see_plant2+ind_frac_dbl2+ind_frac_multi2
aux    total_see_plant = lose_interest+ind_frac_dbl3+ind_frac_multi3
const  ave_net_hire_time = 1
const  ave_order_time_dbl_rpt = 1
const  ave_order_time_dbl1 = 1
const  ave_order_time_dbl2 = 1
const  ave_order_time_dbl3 = 1
const  ave_order_time_multi_rpt = 1
const  ave_order_time_multi1 = 1
const  ave_order_time_multi2 = 1
const  ave_order_time_multi3 = 1
const  ave_time_rcv_dbl = 15
const  ave_time_rcv_multi = 15
const  ecc_price_dbl1 = 150
const  ecc_price_dbl2 = 150
const  ecc_price_dbl3 = 150
const  ecc_price_dbl4 = 150
const  ecc_price_multi1 = 150
const  ecc_price_multi2 = 150
const  ecc_price_multi3 = 150
const  ecc_price_multi4 = 150
const  lose_interest = .05
const  mailing_lists = 1/15
const  margin_to_ecc_price_dbl1 = 0
const  margin_to_ecc_price_dbl2 = 0
const  margin_to_ecc_price_dbl3 = 0
const  margin_to_ecc_price_dbl4 = 0
const  margin_to_ecc_price_multi1 = 0
const  margin_to_ecc_price_multi2 = 0
const  margin_to_ecc_price_multi3 = 0
const  margin_to_ecc_price_multi4 = 0
const  not_sure = .05
const  nrm_cust_per_hour_for_first_quote = 2
const  nrm_repeat_quote_cust_per_hour = 2
const  nrm_scnd_quote_cust_per_hour = 2
const  price_elast_dbl1 = -1
const  price_elast_dbl2 = -1
const  price_elast_dbl3 = -1
const  price_elast_dbl4 = -1
const  price_elast_multi1 = -1
const  price_elast_multi2 = -1
const  price_elast_multi3 = -1
const  price_elast_multi4 = -1
const  ref_cust_dbl1 = .05
const  ref_cust_frac_dbl2 = .05
const  ref_cust_frac_dbl3 = .05
const  ref_cust_frac_dbl4 = .05
const  ref_cust_frac_multi2 = .05
const  ref_cust_frac_multi3 = .05
const  ref_cust_frac_multi4 = .05
const  ref_cust_multi1 = .05
const  see_plant2 = .05
const  switch_out = 1000
const  trade_shows = 1/30
const  work_hours_per_day = 8

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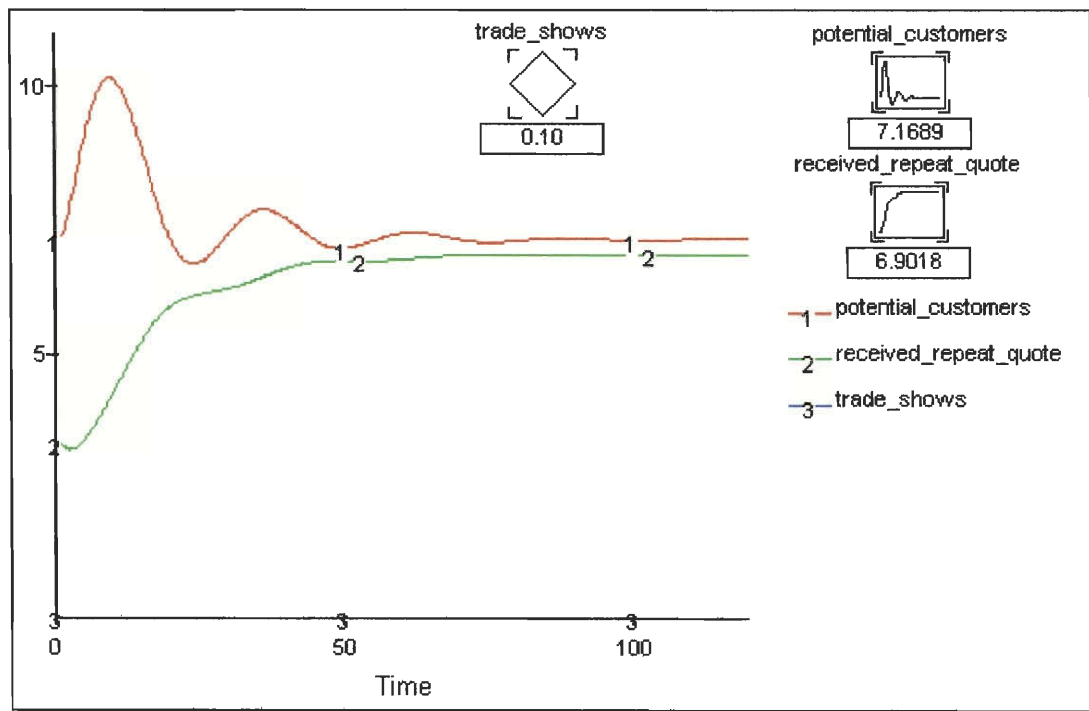
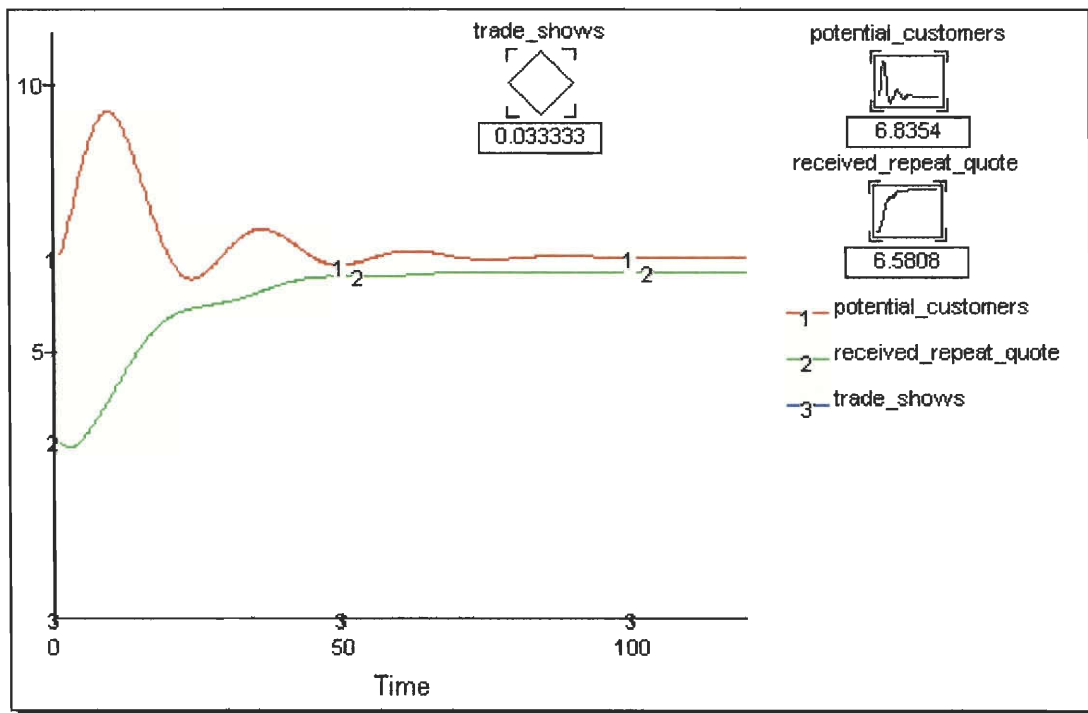
APPENDIX B



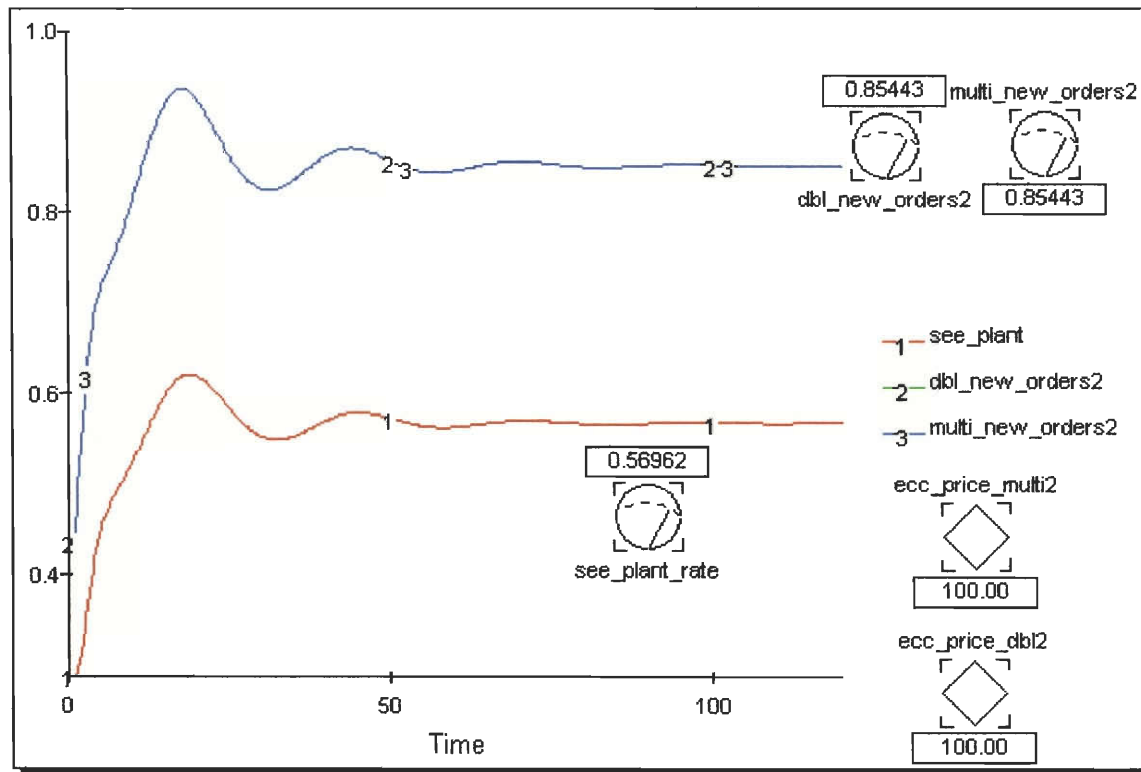
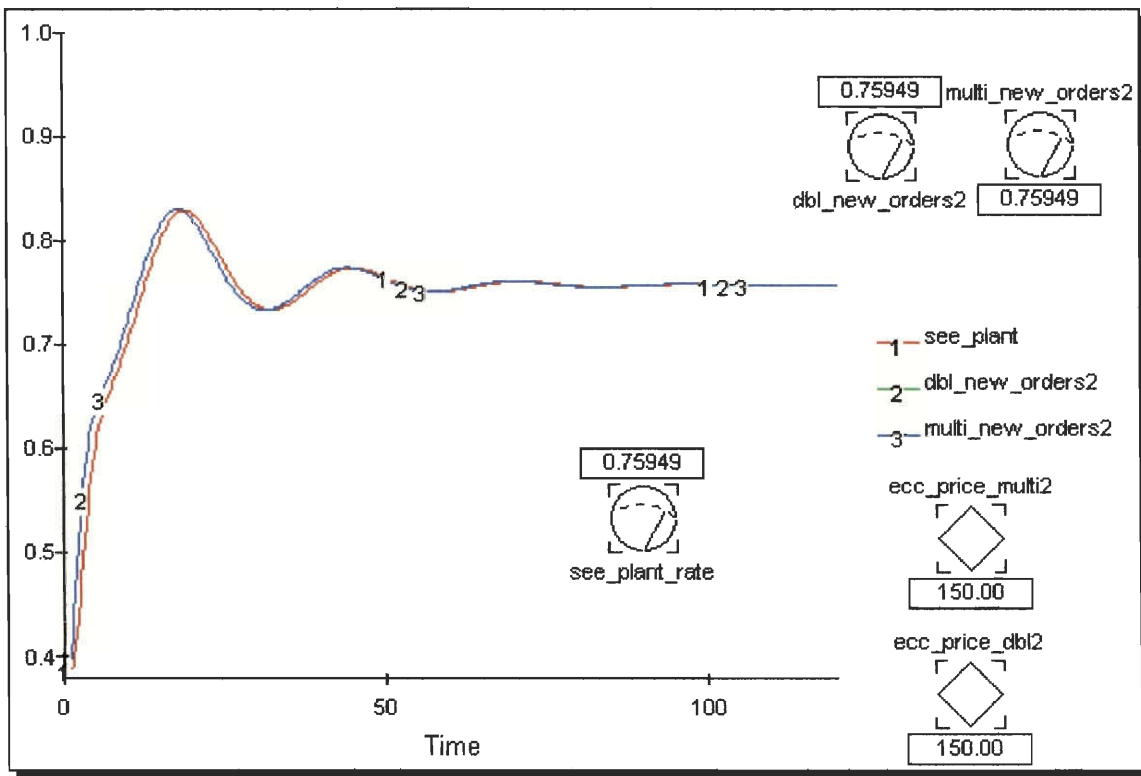
APPENDIX C



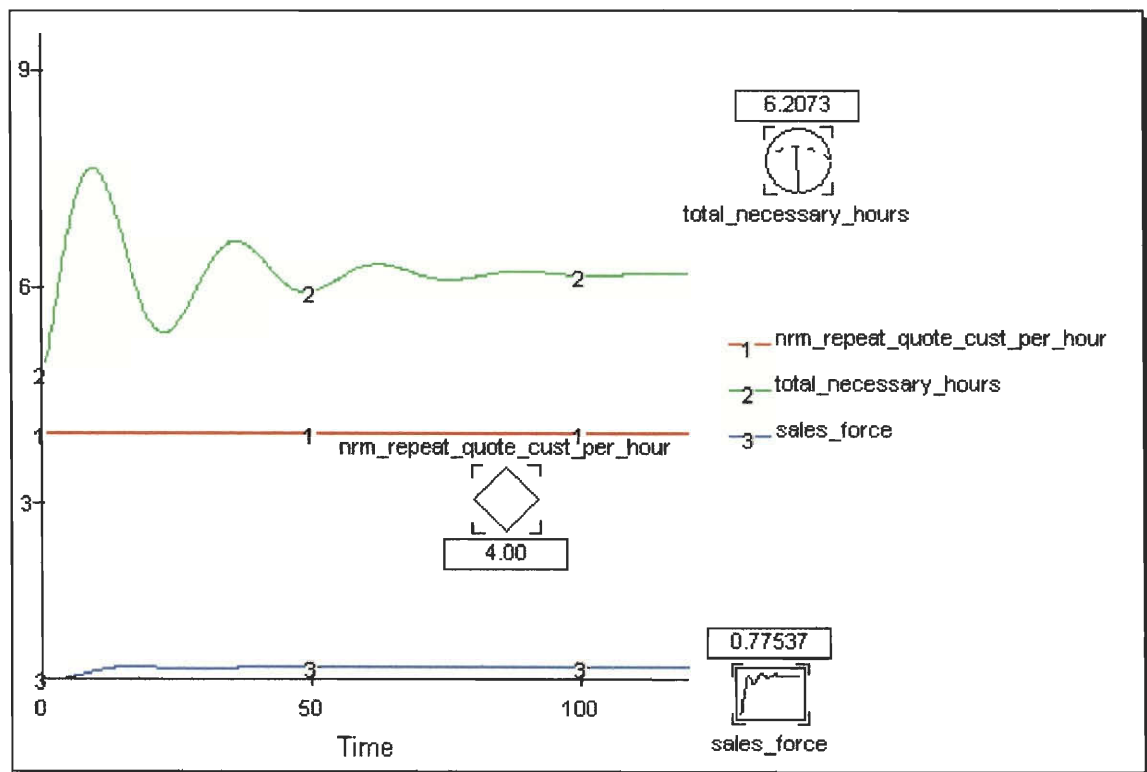
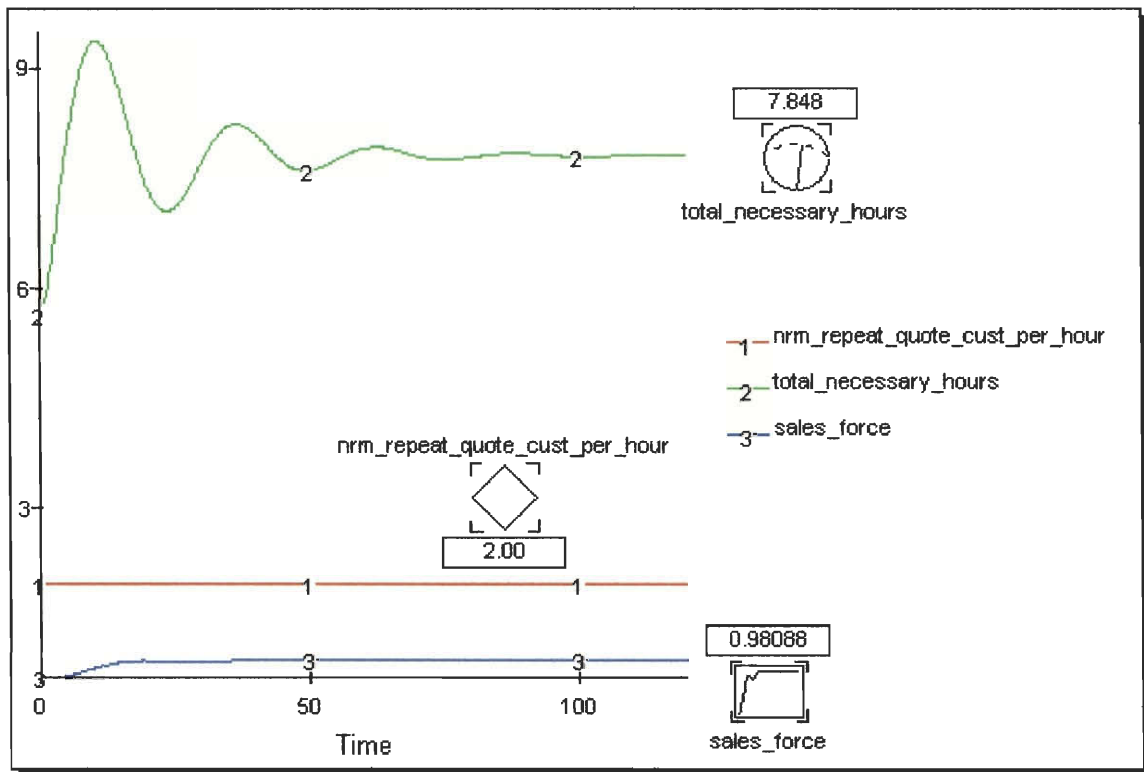
APPENDIX D



APPENDIX E

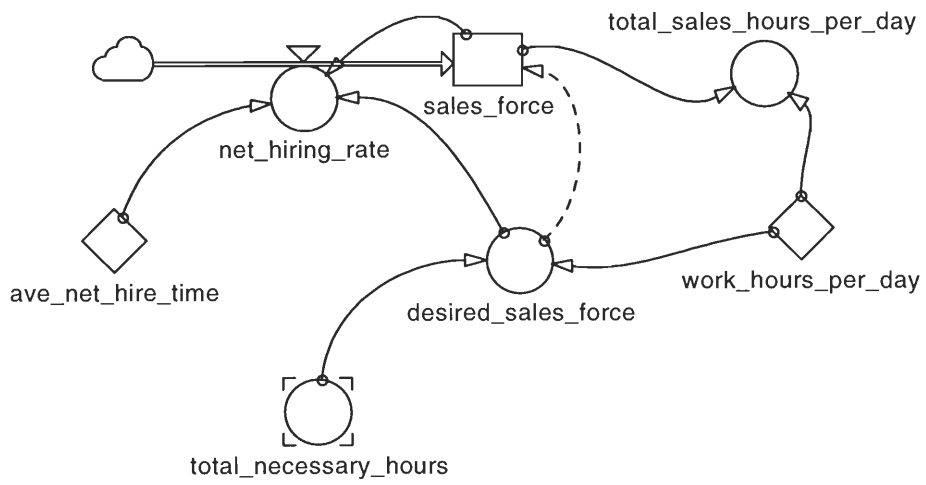


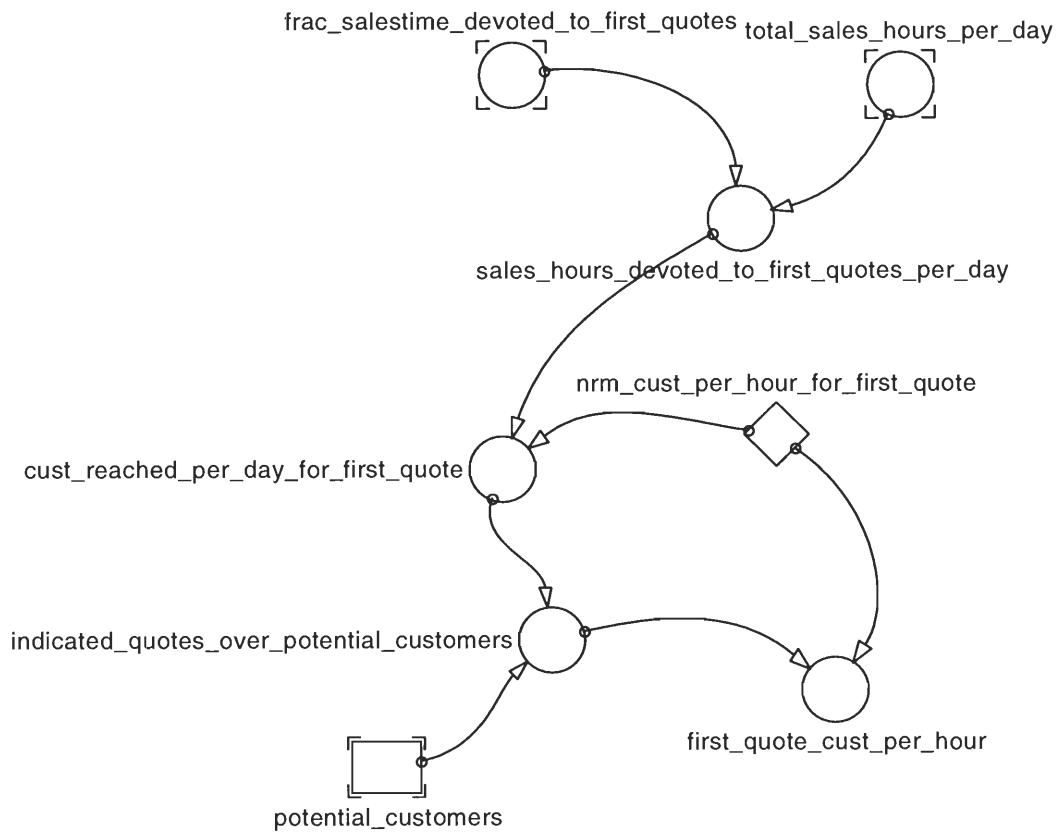
APPENDIX F

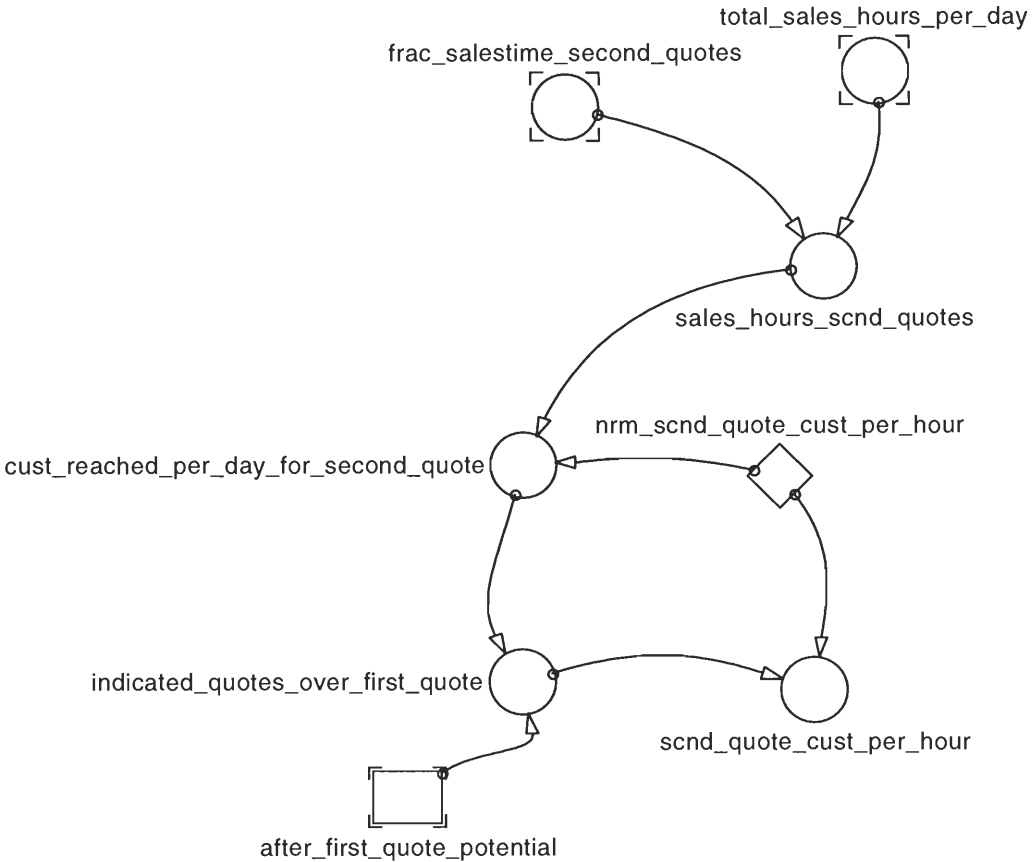


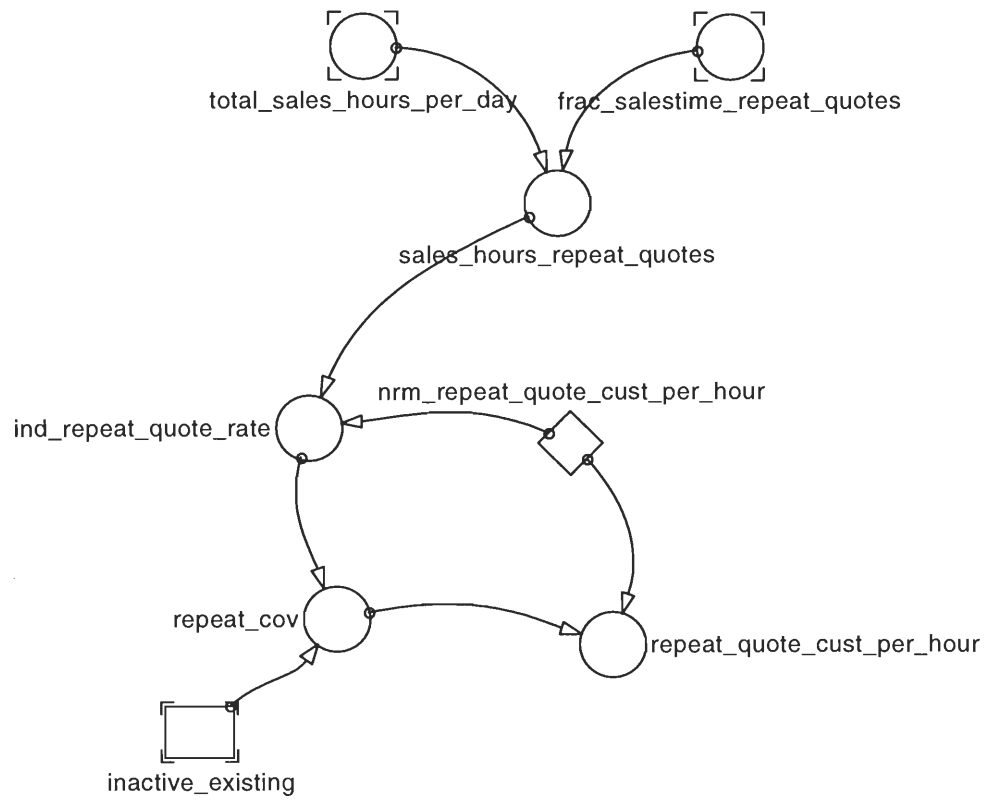
APPENDIX G

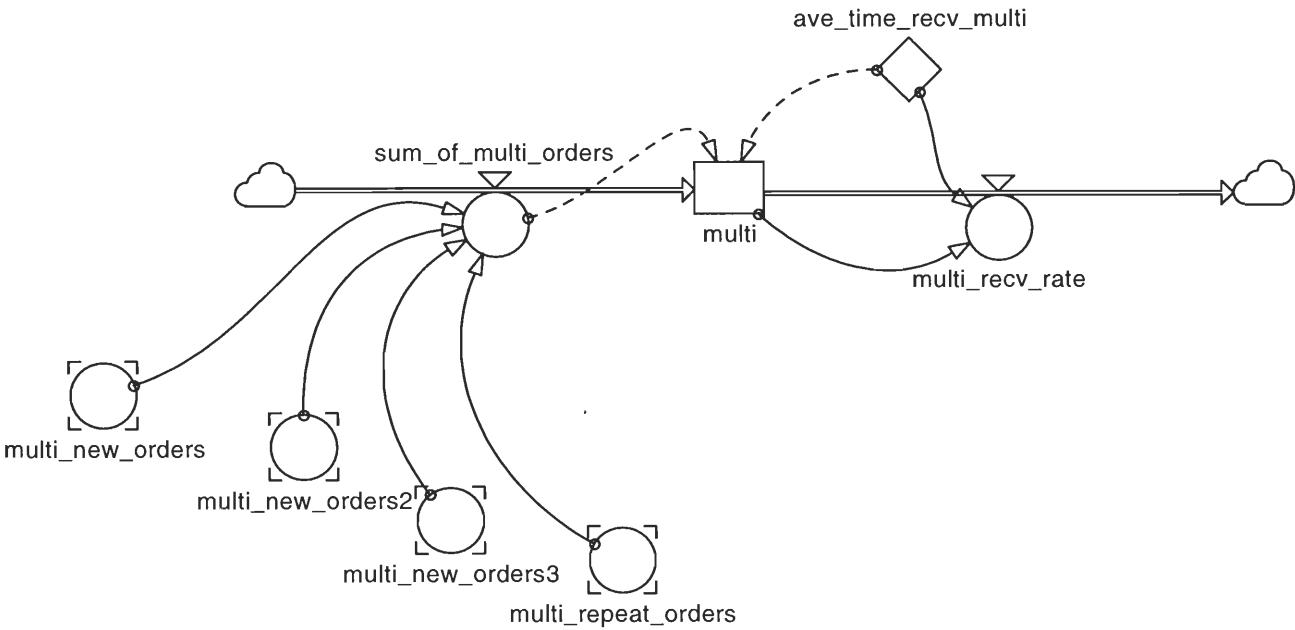
DIAGRAMS OF THE COMPLETE SALES FORCE MODEL

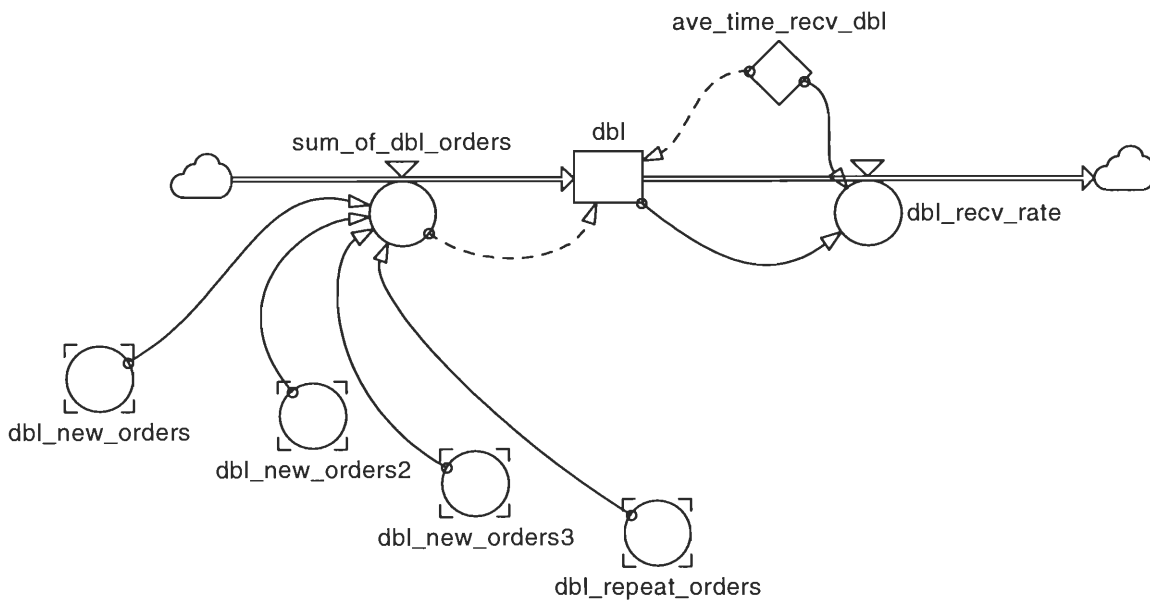


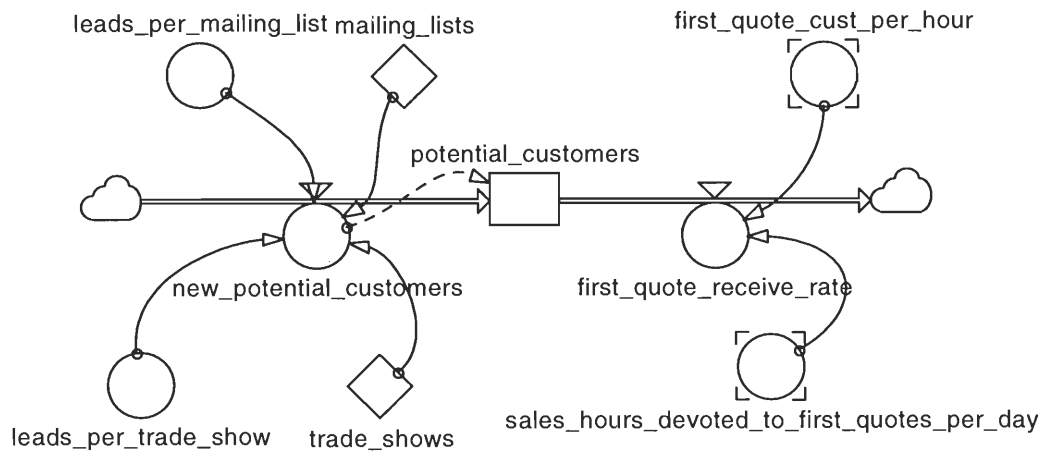


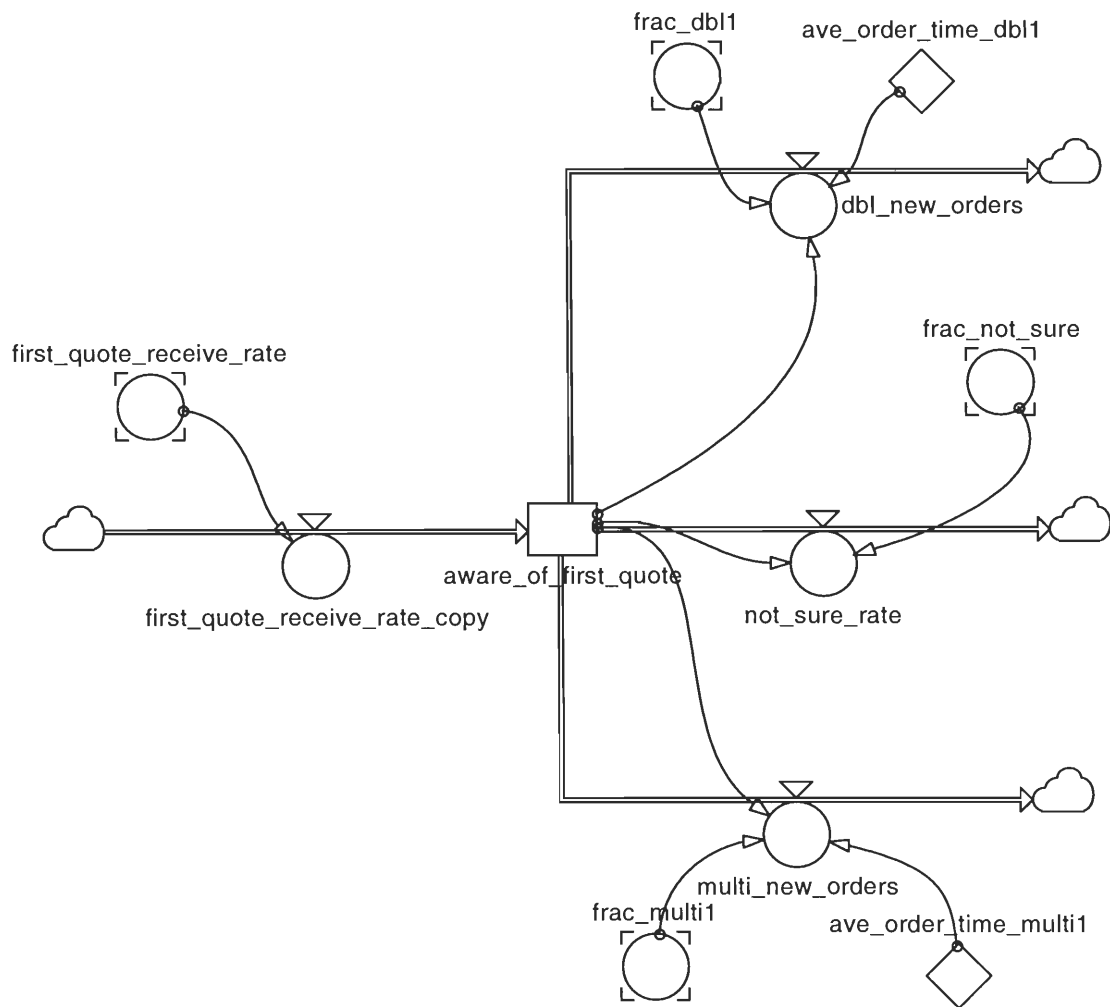


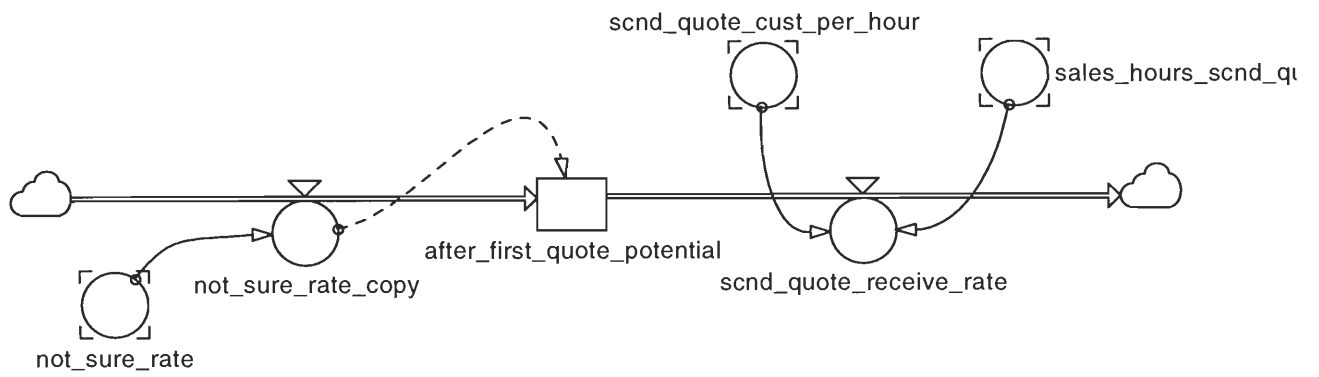




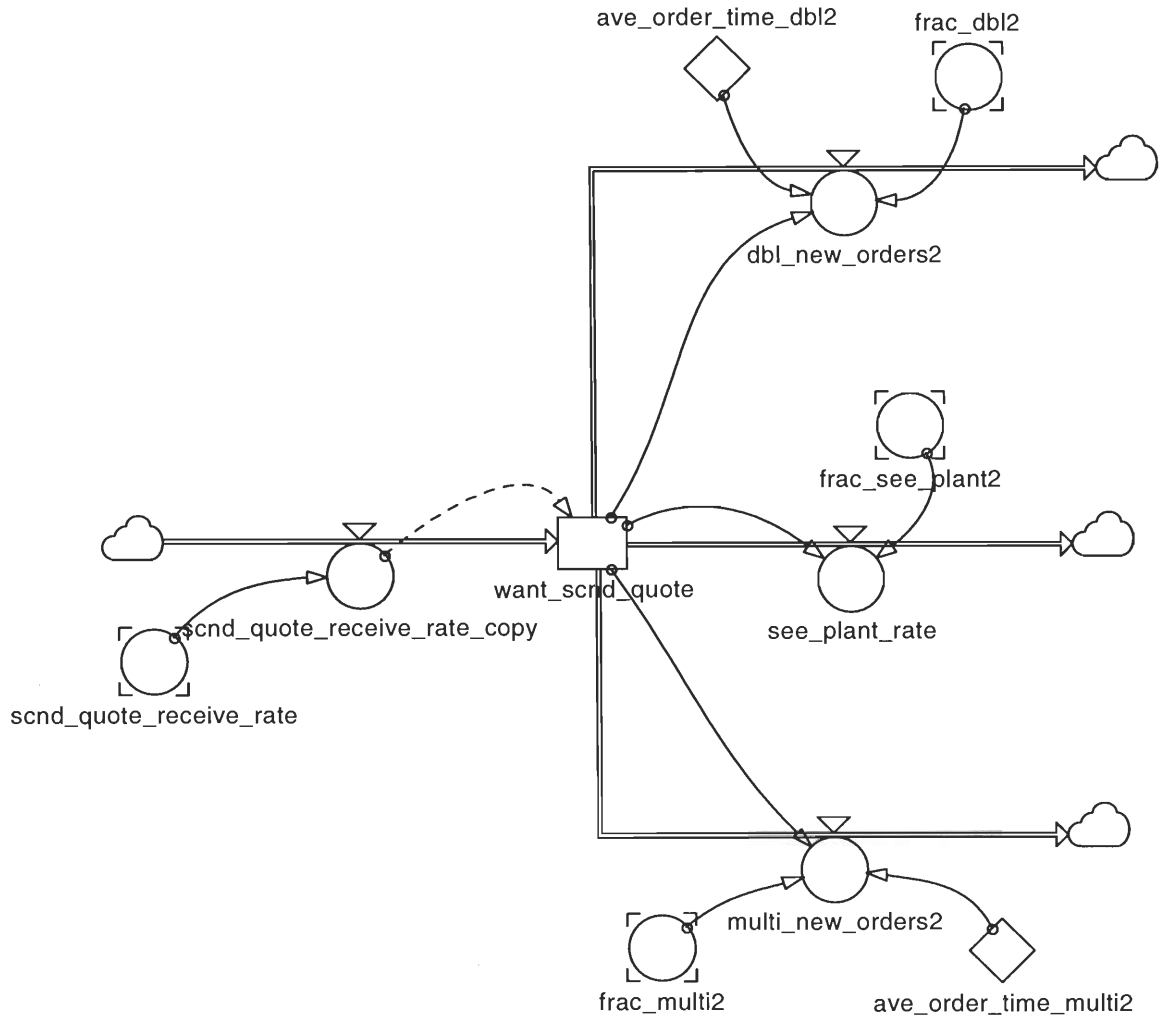


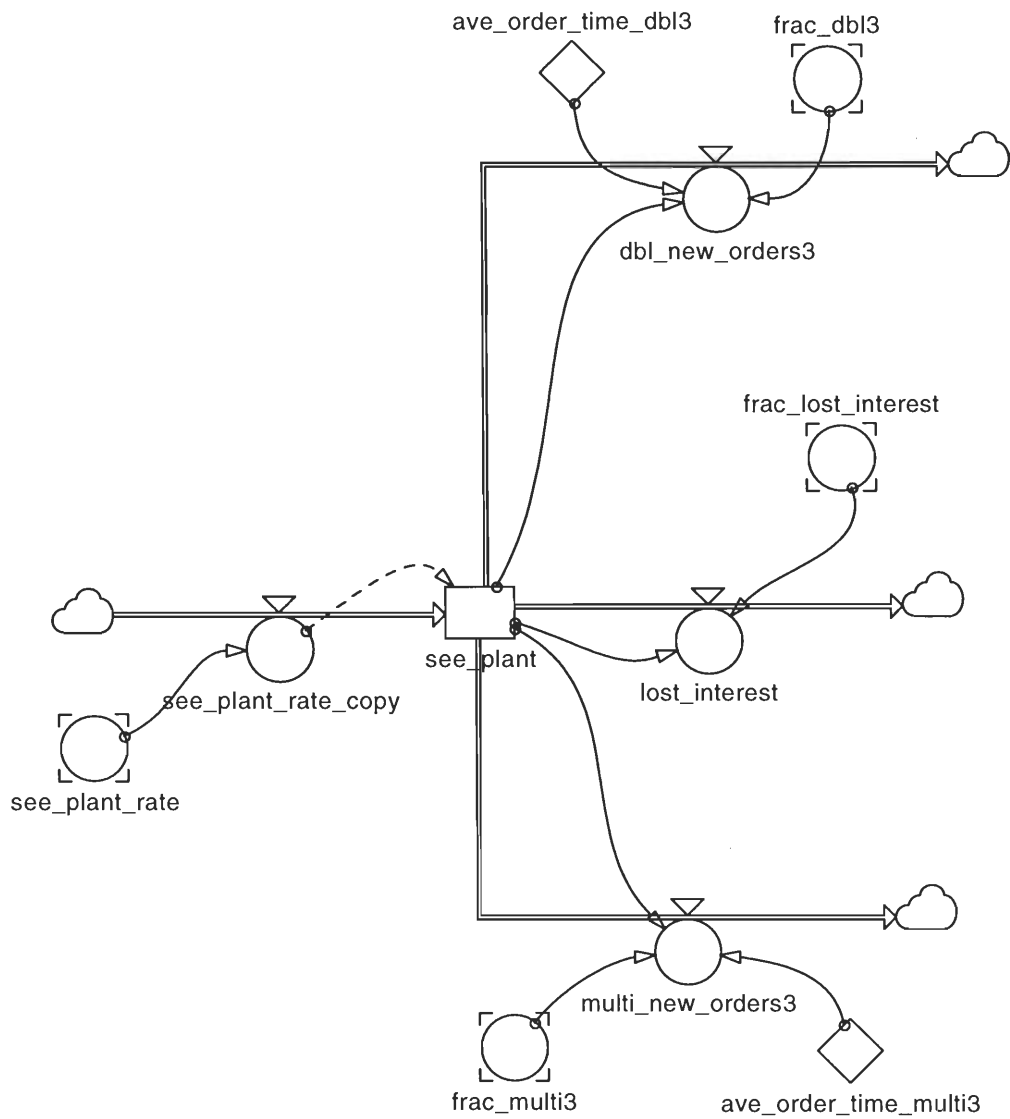


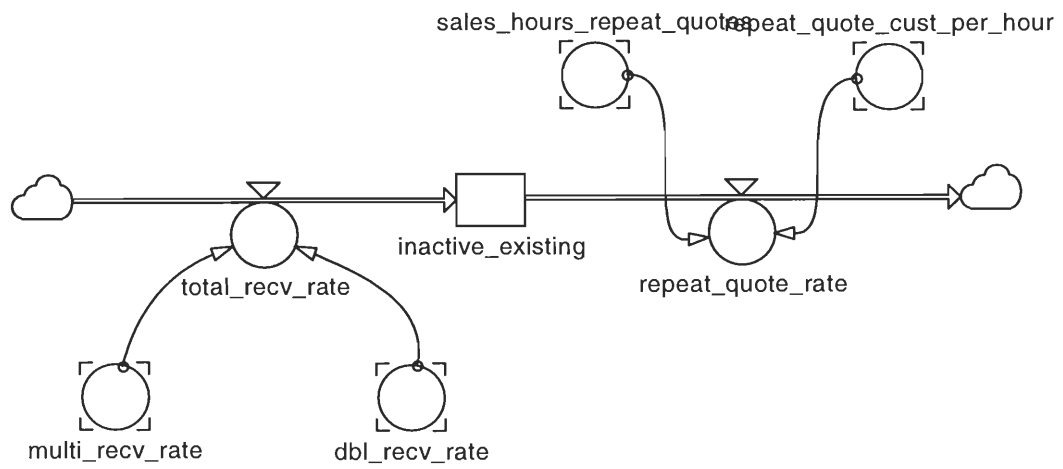


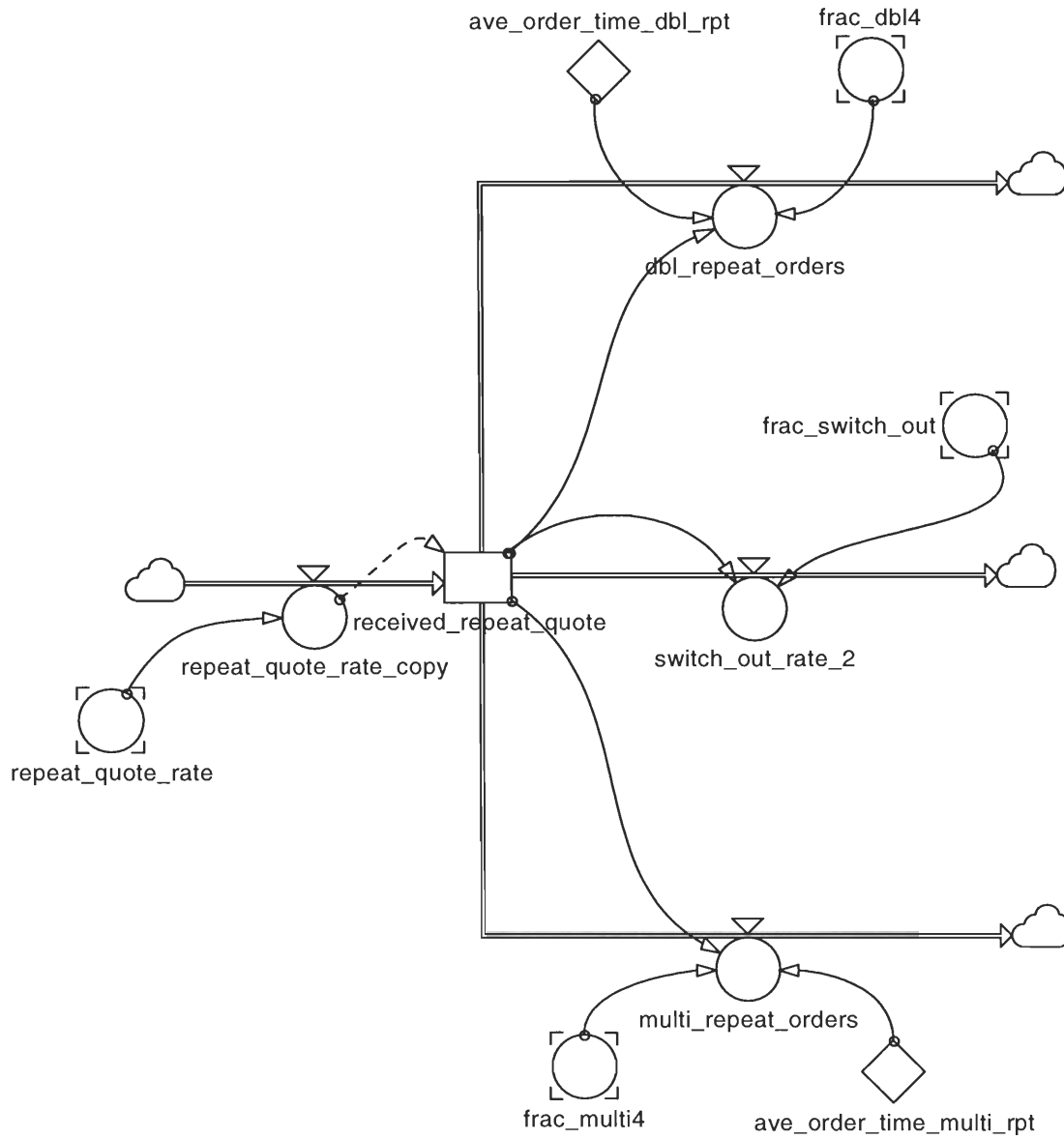


notes

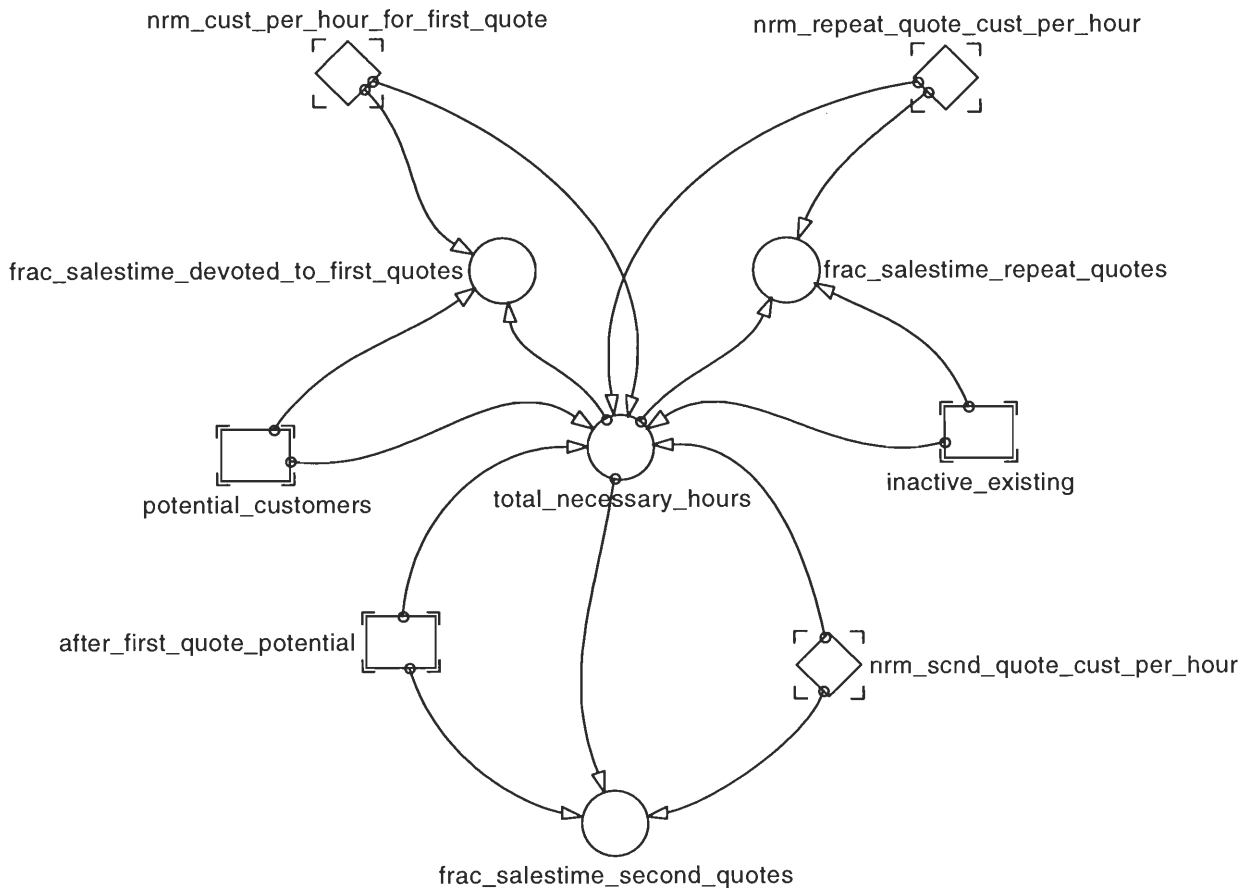


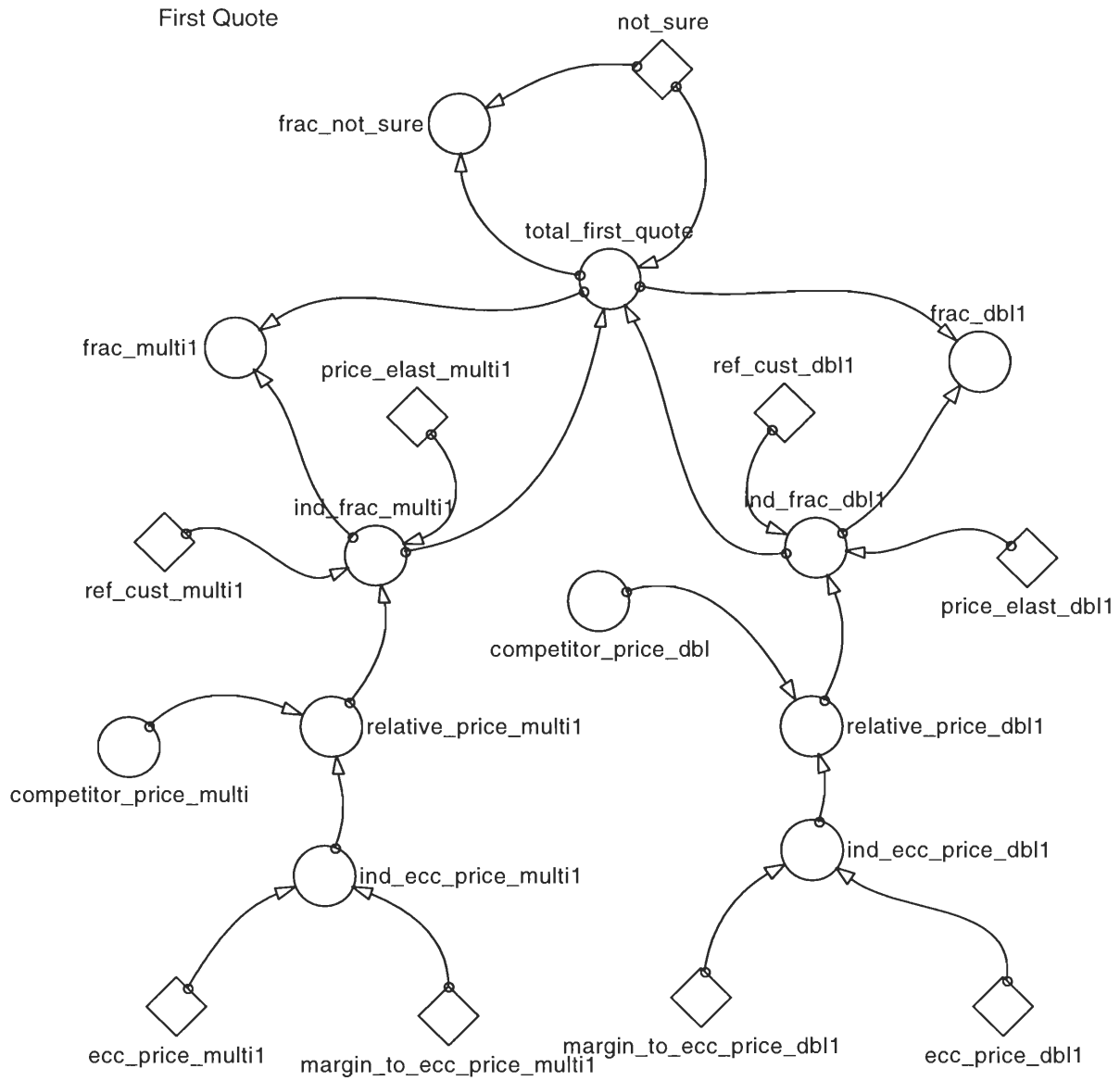




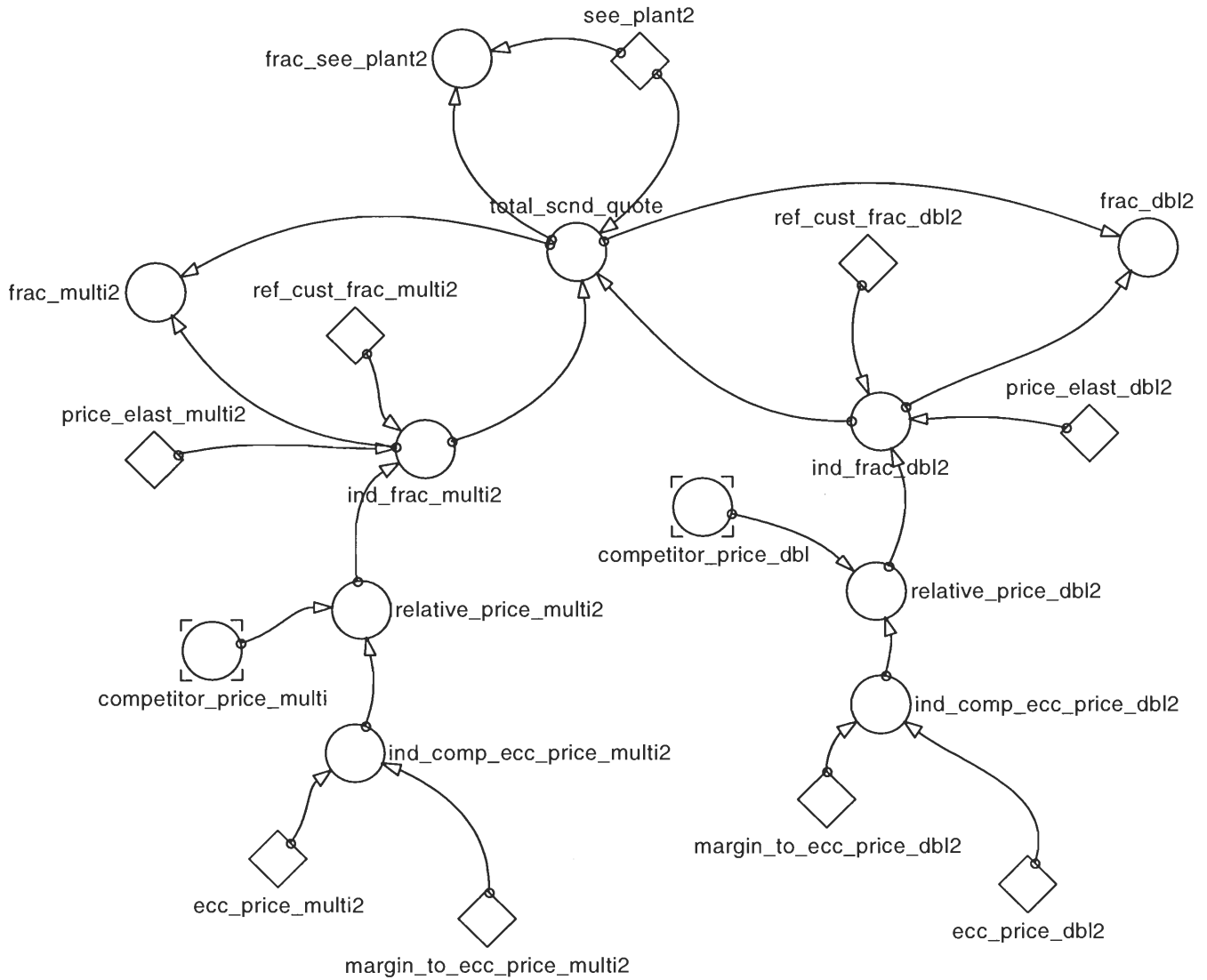


Salesforce Allocation

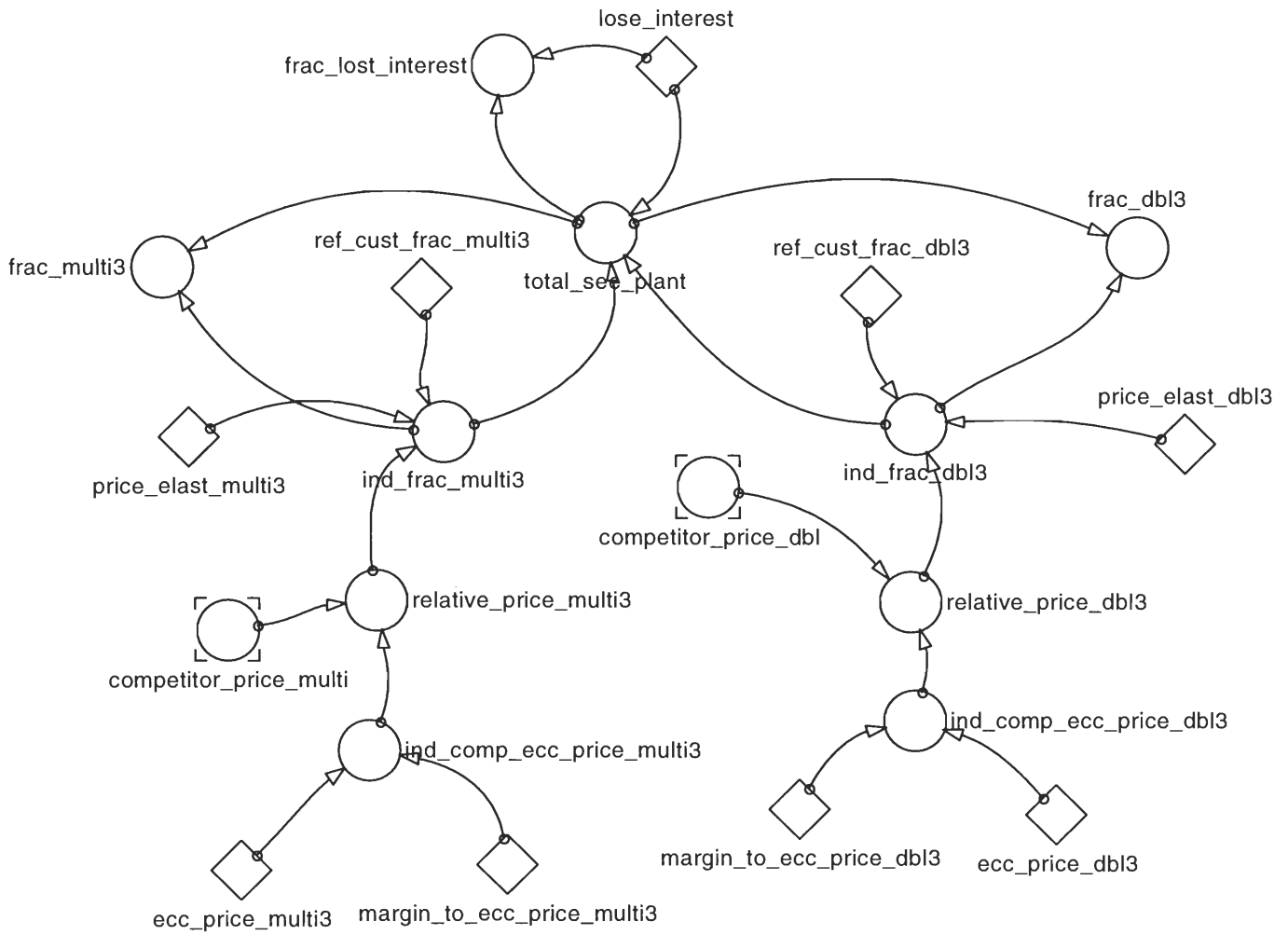




Second Quote



See Plant



Repeat Quote

