PARTNERS OR COMPETITORS? A B2B SIMULATION

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ABSTRACT

This paper describes PC?, a new business simulation for four teams of at least five players each that emphasizes forecasting, supply chain management and business-to-business negotiations in a simplified competitive environment. Although the marketplace uses only two variables, price and promotional budget, to determine firm-level demand, forecasting this demand is complicated by the competitive nature of this simulation. Although supply chain management is simplified by the fact that only four components manufactured independently are needed to produce the final product, the production scheduling is not automated to allow the teams to make critical mistakes. Negotiation occurs because each firm has a competitive advantage in only one of the four components needed to manufacture the final product. Even though all firms have the ability to manufacture all four components, they can lower their costs by purchasing some of the components from their competitors. Hence the question for the title -- are your opponents in this simulation your partners or your competitors?

Keywords: negotiations, supply chain management, forecasting, business-to-business

LESSONS EMBEDDED

THE IMPORTANCE OF INTER-COMPANY NEGOTIATION SKILLS

Negotiation is frequently the key in business-to-business sales. The negotiation results from the fact that each of the two parties involved believe that they can use give-and-take to get a better deal than that his opponent will volunteer to offer. (Lewicki, Saunders, & Minton, 1999). Although many negotiators view this as a win-lose situation, it is not uncommon for suboptimal compromises to occur (Thompson & Hastie, 1990). Essential skills include accurate insight into the other party's interests, establishment of a common ground, and tension reduction (Lewicki, Saunders, & Minton, 1999). Furthermore, most learning about the potential for joint gain occurs in the first few minutes of negotiation and those who learn early earn higher payoffs (Thompson & Hastie, 1990). In this game, each team may negotiate with every other team for component parts of their final product. As each team produces every part, but at differing cost efficiencies, therefore there is a beneficial common ground available for each pair of teams.

THE IMPORTANCE OF GOOD FORECASTING AND SUPPLY CHAIN MANAGEMENT

By improving the ability to forecast demand, companies can avoid issues further down the supply chain. (Blanchard, 2007). If forecasting is not done, retroactive responses lead to lost orders, poor resource use and bad service (Fildes & Hastings, 1994) Yet sales forecasting often receives a low priority in businesses (Hughes, 2001). In this game, forecasting is done by the team CEO when he sets the production output for his team's product at the beginning of each round. Supply chain management is done by the parts coordinator who plans the production schedule for the various components needed to produce the final product. If forecasting is done poorly or the supply chain is mismanaged, it is possible for a company to go out of business and thus lose the game.

SCENARIO

Four manufacturers (Cougar, Lynx, Puma and Wildcat) produce Bobcat™-type front-end loaders. These front-end loaders are composed of four major components: the engine, the transmission/drive train, the hydraulic system and the electronics control system. While each manufacturer has the ability to produce all four components as well as the front-end loader, efficiency varies with the component. The costs to the manufacturers per component produced are as follows:

- Cougar produces engines at a cost of $70 each, transmissions at a cost of $80 each, hydraulics at a cost of $90 each and electronics at a cost of $100 each.
- Lynx produces engines at a cost of $100 each, transmissions at a cost of $70 each, hydraulics at a cost of $80 each and electronics at a cost of $90 each.

- Puma produces engines at a cost of $90 each, transmissions at a cost of $100 each, hydraulics at a cost of $70 each and electronics at a cost of $80 each.
- Wildcat produces engines at a cost of $80 each, transmissions at a cost of $90 each, hydraulics at a cost of $100 each and electronics at a cost of $70 each.

To produce one front-loader, the manufacturer requires one engine, one transmission/drive train, one hydraulic system, and one electronics control system, $60 in other raw materials, and $200 in labor. As a manufacturer can negotiate once each round with each of the other manufacturers for each component, it is possible to reduce the production costs per front-end loader. Fixed costs are set at $5,000,000 per round. If the combined requested production of components and loaders increases from the prior round, an additional surcharge of $10 per unit above the number produced in the prior round is applied to reflect expansion costs such as the purchase of additional equipment and the hiring of additional labor. If the combined requested production of components and loaders decreases from the prior round, an additional surcharge of $5 per unit below the number produced in the prior round is applied to reflect shrinkage costs such as the mothballing of equipment and layoffs.

TEAM STRUCTURE

Each team (manufacturer) consists of a CEO, a parts coordinator, and at least three negotiators. If three negotiators per team (or a multiple thereof) are used, six negotiating groups are formed, consisting of agents from each team in the following pairs: Cougar-Lynx, Cougar-Puma, Cougar-Wildcat, Lynx-Puma, Lynx-Wildcat and Puma-Wildcat. If four negotiators per team (or a multiple thereof) are used, four negotiating groups are formed, consisting of agents from each team in the following clusters: engines, transmission/drive trains, hydraulic systems, and electronic control systems. As the computer-assisted processing system (available by contacting the first author) records completed contracts by both the teams involved and the part involved, the configuration of the negotiating groups can be left to the instructor's discretion. The remainder of this paper will assume that team-pair groups were used.

The responsibilities of each team member in each round are as follows:

- CEO: sets the product price, promotion budget and front-end loader production output. A good CEO will forecast the demand to prevent the loss of orders and to avoid shrinkage costs such as layoffs. Extra front-end loaders may be inventoried from round to round, however a carrying cost of $200 per loader is applied at the end of the round. Unsatisfied demand either disappears or goes to importers which are not reported in the game.
- Parts coordinator: determines the production schedule for each of the components necessary to meet the planned front-end loader output and the component output sold to other manufacturers. A good parts coordinator will work with his buying agents to purchase components at a price cheaper than his company can manufacture them. A good parts coordinator will also work with his selling agents to ensure that his company does not end up selling more components than it can reasonably produce. Extra parts may be inventoried from round to round, however a carrying cost of $20 per component is applied at the end of the round.
- Negotiator: bargains both the price and the quantity of components to be purchased from and sold to another team. In a large class, this role can be separated into a buying agent who arranges for the purchase of components to be used by his own team and a selling agent who arranges for the sale of components to be used by the other team. A good negotiator will quickly identify the beneficial common ground as the negotiation time should be limited.

GAME FLOW

As this is a business-to-business simulation, industry-level demand is set by forces outside of the competitors' control. Aggregate industry demand is influenced by changes in the national economy, government contracts for road building and other macro-economic conditions. To reflect this, the game administrator sets the industry level demand at the beginning of each round. Although the instructor can set the number of rounds and the industry-level demand in each round to reflect the needs of his course, it is suggested that eight rounds be played as follows to reflect the product life cycle curve:

1	Introduction 1:	Industry-level demand is set at 10% of the peak demand
2	Introduction 2:	Industry-level demand is increased to 25% of the peak demand
3	Growth 1:	Industry-level demand is increased to 50% of the peak demand
4	Growth 2:	Industry-level demand is increased to 75% of the peak demand
5	Maturity 1:	Industry-level demand is increased to 100% of the peak demand
6	Maturity 2:	Industry-level demand is held at 100% of the peak demand
7	Decline 1:	Industry-level demand is decreased to 80% of the peak demand
8	Decline 2:	Industry-level demand is decreased to 60% of the peak demand

Other patterns for the industry-level aggregate demand could be used, depending on the macro-economic conditions desired by the instructor. All industry-level demand could be constant if the forecasting aspects of this simulation needed to be simplified. Industry-level demand could be constant except for a recession during one or two periods in the middle of the simulation in which demand is decreased drastically. To reflect research done prior to a company's entry into a market and to prevent the team CEOs from setting their initial forecast randomly, it is suggested that the instructor announce either the industry-level demand for the first round or the peak demand at the start of the game.

Pricing and marketing expenditures affect the allocation of the industry demand to each firm. At the beginning of each round, each team's CEO sets the price, promotion budget and the production output for his company's loader. He should consider both the components on hand and the loaders inventoried when determining this. Next, the production output is handed to the parts coordinator who determines the components needed to satisfy this requirement. He should consider the components on hand and the cost efficiencies for his team prior to telling the negotiators what parts in what amounts to get at a lower price than his company can manufacture. The negotiators bargain and then complete the contract form shown in figure 1, where other considerations allow for the recording of bribes and incentives.

After reporting back to the parts coordinator concerning completed negotiations, the contract form is given to the instructor to be input into the computer-assisted processing system. Only one contract between the same buyer and seller for the same component may be submitted to the instructor in any given round. Once negotiations are completed, the parts coordinator and CEO provide the production schedule to the instructor using the form in figure 2 (variables used later in this paper are in parentheses). This information is also input into the computer-assisted processing system and the results of the round are obtained. These are then reported back to the teams in preparation for the beginning of the next round.

GAME PROCESSING

At the beginning of the game, the instructor sets the starting balance that each team receives. The game administrator also sets the following parameters for the firm-level demand function:

- The lowest price at which a change in the demand response is seen (min_p)
- The price at which diminishing returns is seen (μ_p)
- The highest price at which a change in the demand response is seen (max_p)
- The lowest promotion budget at which a change in the demand response is seen (min_m)
- The promotion budget at which diminishing returns is seen (μ_m)
- The highest price at which a change in the demand response is seen (max_m)

Figure 3 should make these parameters more apparent.

Although it is necessary that μ be placed between min and max, it is not necessary that it be symmetric as shown in figure 3. No holdover effects are used in this game to simplify the forecasting demands on the student teams. Furthermore, two independent triangular distributions are used to generate the firm-level demand function as an approximation to the more complicated MTS function (Murff, Teach, & Schwartz, 2007). Let Q be the industry-level demand set by the instructor for a given round. Each

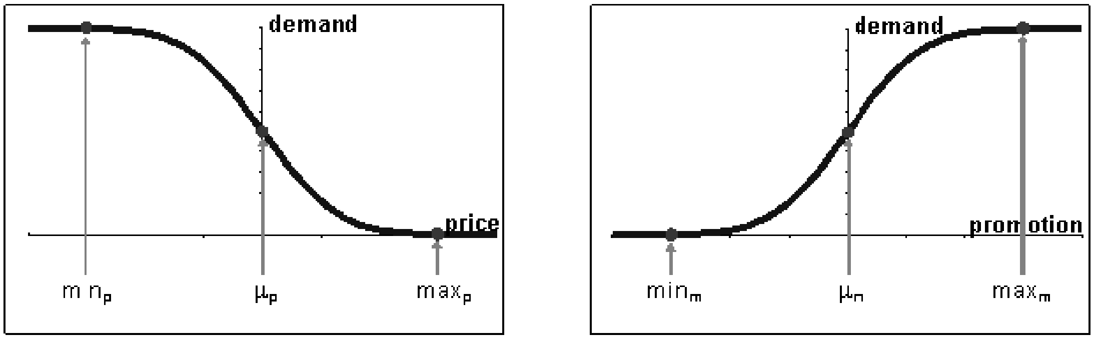
Figure 1
Negotiation Contract

Round		Selling company & signature	
Component		Other considerations paid by seller	
Price per component		Buying company & signature	
Number of components		Other considerations paid by buyer	

Figure 2
Production Schedule

Company name		
Responsible party	Item	Quantity
Parts coordinator	# of engines	(en_I)
	# of transmission/drive trains	(tr_I)
	# of hydraulics	(hy_I)
	# of electronics	(el_I)
CEO	# of front-end loaders	(L_I)
	Price per loader in $	(P_I)
	Promotion budget in $	(M_I)

Figure 3
Parameters of the Firm-level Demand Equation



firm (I = 1 to 4) provides a price per loader P_I and a promotion budget M_I to the instructor for this round. Then the price weight function and the promotion weight functions are calculated as follows for each firm:

$$WP_I = \begin{cases} 1 & if \quad P_I < min_p \\ 1 - \dfrac{(P_I - min_p)^2}{(max_p - min_p)(\mu_p - min_p)} & if \quad min_p \leq P_I < \mu_p \\ \dfrac{(max_p - P_I)^2}{(max_p - min_p)(max_p - \mu_p)} & if \quad \mu_p \leq P_I < max_p \\ 0 & if \quad P_I \geq max_p \end{cases}$$

$$WM_I = \begin{cases} 0 & if \quad M_I < min_m \\ \dfrac{(M_I - min_m)^2}{(max_m - min_m)(\mu_m - min_m)} & if \quad min_m \leq M_I < \mu_m \\ 1 - \dfrac{(max_m - M_I)^2}{(max_m - min_m)(max_m - \mu_m)} & if \quad \mu_m \leq M_I < max_m \\ 1 & if \quad M_I \geq max_m \end{cases}$$

Then the firm-level demand for each team's loader is calculated as follows:

$$Q_I = Q\left(\frac{WP_I}{\sum_{I=1}^{4} WP_I}\right)\left(\frac{WM_I}{\sum_{I=1}^{4} WM_I}\right)$$

Once the firm-level demand for a team is obtained, a balance sheet for each company is generated using the computer-assisted processing system. For the Cougar Company (I=1), the calculations would be as in table 1, where variables in parentheses are inputs from the team's play in the given round.

The total of the last column will be the net change in Cougar's dollar balance for the given round. The calculations for the other teams are similar. If a firm's balance goes below zero, it has gone bankrupt. Depending on the circumstances of the simulation's use, the instructor can either remove the firm from play or provide an emergency loan with a high interest rate to keep the firm involved in the simulation.

Table 1
Balance Sheet (and calculation formulae) for Cougar

	Units	\$/unit	Net change \$
Engines			
• produced	(en_1)	-70	$-70*en_1$
• held over from prior round	$enH_{1(prior\ round)}$		
• bought from Lynx	(en_{12})	$-(p_{en,12})$	$-p_{en,12}*en_{12}$
• bought from Puma	(en_{13})	$-(p_{en,13})$	$-p_{en,13}*en_{13}$
• bought from Wildcat	(en_{14})	$-(p_{en,14})$	$-p_{en,14}*en_{14}$
• sold to Lynx	(en_{21})	$+(p_{en,21})$	$+p_{en,21}*en_{21}$
• sold to Puma	(en_{31})	$+(p_{en,31})$	$+p_{en,31}*en_{31}$
• sold to Wildcat	(en_{41})	$+(p_{en,41})$	$+p_{en,41}*en_{41}$
• available for loaders	$enA_1 = \min[0, en_1 + enH_{1(prior\ round)} + en_{12} + en_{13} + en_{14} - en_{21} - en_{31} - en_{41}]$		

Transmission/drive trains			
• produced	(tr_1)	-80	$-80*tr_1$
• held over from prior round	$trH_{1(prior\ round)}$		
• bought from Lynx	(tr_{12})	$-(p_{tr,12})$	$- p_{tr,12}*tr_{12}$
• bought from Puma	(tr_{13})	$-(p_{tr,13})$	$- p_{tr,13}*tr_{13}$
• bought from Wildcat	(tr_{14})	$-(p_{tr,14})$	$- p_{tr,14}*tr_{14}$
• sold to Lynx	(tr_{21})	$+(p_{tr,21})$	$+p_{tr,21}*tr_{21}$
• sold to Puma	(tr_{31})	$+(p_{tr,31})$	$+p_{tr,31}*tr_{31}$
• sold to Wildcat	(tr_{41})	$+(p_{tr,41})$	$+p_{tr,41}*tr_{41}$
• available for loaders	$trA_1 = min[0, tr_1 + trH_{1(prior\ round)} + tr_{12} + tr_{13} + tr_{14} – tr_{21} – tr_{31} – tr_{41}]$		
Hydraulics			
• produced	(hy_1)	-90	$-90*hy_1$
• held over from prior round	$hyH_{1(prior\ round)}$		
• bought from Lynx	(hy_{12})	$-(p_{hy,12})$	$- p_{hy,12}*hy_{12}$
• bought from Puma	(hy_{13})	$-(p_{hy,13})$	$- p_{hy,13}*hy_{13}$
• bought from Wildcat	(hy_{14})	$-(p_{hy,14})$	$- p_{hy,14}*hy_{14}$
• sold to Lynx	(hy_{21})	$+(p_{hy,21})$	$+p_{hy,21}*hy_{21}$
• sold to Puma	(hy_{31})	$+(p_{hy,31})$	$+p_{hy,31}*hy_{31}$
• sold to Wildcat	(hy_{41})	$+(p_{hy,41})$	$+p_{hy,41}*hy_{41}$
• available for loaders	$hyA_1 = min[0, hy_1 + hyH_{1(prior\ round)} + hy_{12} + hy_{13} + hy_{14} – hy_{21} – hy_{31} – hy_{41}]$		
Electronics			
• produced	(el_1)	-100	$-100*el_1$
• held over from prior round	$elH_{1(prior\ round)}$		
• bought from Lynx	(el_{12})	$-(p_{el,12})$	$- p_{el,12}*el_{12}$
• bought from Puma	(el_{13})	$-(p_{el,13})$	$- p_{el,13}*el_{13}$
• bought from Wildcat	(el_{14})	$-(p_{el,14})$	$- p_{el,14}*el_{14}$
• sold to Lynx	(el_{21})	$+(p_{el,21})$	$+p_{el,21}*el_{21}$
• sold to Puma	(el_{31})	$+(p_{el,31})$	$+p_{el,31}*el_{31}$
• sold to Wildcat	(el_{41})	$+(p_{el,41})$	$+p_{el,41}*el_{41}$
• available for loaders	$elA_1 = min[0, el_1 + elH_{1(prior\ round)} + el_{12} + el_{13} + el_{14} – el_{21} – el_{31} – el_{41}]$		
Loaders			
• Component sets available	$LC_1 = min[enA_1, trA_1, hyA_1, elA_1]$		
• Production output desired	(L_1)		
• Produced	$LP_1 = min[LC_1, L_1]$	-260	$-260*LP_1$
• Held over from prior round	$LH_{1(prior\ round)}$		
• Available for sale	$LA_1 = LP_1 + LH_{1(prior\ round)}$		
• Desired by market	Q_1		
• Sold	$LS_1 = min[Q_1, LA_1]$	(P_1)	$+P_1*LS_1$
Inventoried to next round			
• Engines	$enH_1 = max[0, enA_1 – LP_1]$	-20	$-20*enH_1$
• Transmission/drive trains	$trH_1 = max[0, trA_1 – LP_1]$	-20	$-20*trH_1$
• Hydraulics	$hyH_1 = max[0, hyA_1 – LP_1]$	-20	$-20*hyH_1$
• Electronics	$elH_1 = max [0, elA_1 – LP_1]$	-20	$-20*elH_1$
• Loaders	$LH_1 = max[0, LA_1 – LS_1]$	-200	$-200*LH_1$

Expansion/Shrinkage			
• Expansion costs	$EC_1 = \max[0, LP_1 - LP_{1(prior\ round)} + en_1 - en_{1(prior\ round)} + tr_1 - tr_{1(prior\ round)} + hy_1 - hy_{1(prior\ round)} + el_1 - el_{1(prior\ round)}]$	-10	$-10*EC_1$
• Shrinkage costs	$SC_1 = \max[0, LP_{1(prior\ round)} - LP_1 + en_{1(prior\ round)} - en_1 + tr_{1(prior\ round)} - tr_1 + hy_{1(prior\ round)} - hy_1 + el_{1(prior\ round)} - el_1]$	-5	$-5*SC_1$
Other costs			
• Promotion budget			$-(M_1)$
• Fixed costs			-5000000
• Other monetary consideration received from Lynx			$+(br_{12})$
• Other monetary consideration received from Puma			$+(br_{13})$
• Other monetary consideration received from Wildcat			$+(br_{14})$
• Other monetary consideration paid to Lynx			$-(br_{21})$
• Other monetary consideration paid to Puma			$-(br_{31})$
• Other monetary consideration paid to Wildcat			$-(br_{41})$

SCORING

Scoring for this game can be done in one of several ways:

- The simplest is the overall balance at the end of the rounds less the starting balance at the beginning of the game. This reflects the overall profit earned as all teams start with the same balance. In this case, the largest score would be desired. However, this is subject to the dominance phenomenon in which a team that "gets lucky" early in the game becomes powerful enough to dominate the industry and win the game (Teach & Patel, 2007). As this does not promote the experimentation desired for experiential learning in the classroom, this method of scoring is not recommended.
- If a focus on just forecasting is preferred, the absolute forecast deviation may be used for scoring. This is easily calculated for team I by taking the absolute value of the difference between the production output desired, L_I, and the market demand, Q_I, in each round and then summing. In this case, the smallest score would be desired.
- If a method that reflects the game overall is preferred, the overall profit earned divided by the absolute forecast deviation is suggested. In this case, the largest score would be desired.

DEBRIEFING

Depending on the course in which this game is used, the debriefing for this game can focus on forecasting, negotiations, supply chain management, within-team dynamics or any combination thereof at the instructor's discretion.

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