LINKS Tutorial #4:
Forecasting

Katrina A. Zalatan & Randall G. Chapman

LINKS firms are evaluated on financial, operating, and customer-related results. **Planning** is the process you go through to make decisions to achieve these results. **Forecasting** is a critical part of the planning process.

This tutorial is divided into two parts. Each part ends with a "hands-on" exercise. Here is an outline of tutorial and the questions that comprise each exercise:

1. What is Forecasting?

In LINKS, **forecasting** refers to your ability to predict sales volumes. Every simulation round, you'll prepare sales volume forecasts for each of your products. You'll create the following forecasts[1]:

…**sales forecasts** for <u>next round</u> ("the short-term") by channel, by region, by product and…

…the <u>next two rounds</u> after that ("the long-term") by product.

<u>Forecasting Decisions</u>

Firm		Month	

Short-Term (i.e., Next Round) Sales Volume Forecast, Channel #1	Region 1	Region 2	Region 3
Product 1			
Product 2			

Short-Term (i.e., Next Round) Sales Volume Forecast, Channel #2	Region 1	Region 2	Region 3
Product 1			
Product 2			

Long-Term (i.e., 2- and 3-Rounds Hence) Sales Volume Forecasts	2-Rounds Hence	3-Rounds Hence
Total Sales Volume, Product 1		
Total Sales Volume, Product 2		

In all cases, great forecasts are very close estimates of what actually happens in the future. For example, you forecast that you'd sell 100 units of product 1-1 in channel 1 in region 1 in round 4, and when round 4 came around, you sell exactly that. You were 100% accurate. That's the ideal. But forecasts could also be too high or too low in varying degrees, with consequent forecasting accuracy of less than 100%.

[1] Some LINKS Simulations require only short-term sales volume forecasts. Other LINKS Simulations require both short-term and long-term sales volume forecasts.

Your LINKS reports summarize your forecasting accuracy in two places:

1. An overall "forecasting accuracy" score that's one of the operational metrics on your *Performance Evaluation Report* (page 1 of your financial reports).
2. A more detailed *Forecasting Accuracy Report* that reports the accuracy of your sales volume forecasts individually and in aggregate for your firm as a whole.

This tutorial focuses on the process of sales forecasting and the implications that forecasting accuracy has for your firm's performance.

EXERCISE #1: Your Own Forecasting Process

Work through each of the following questions, then review the "answers" on the next page.

1. Inputs to Forecast Sales: What "inputs" should you consider when making your sales volume forecasts?

2. Input Sources: Where can you find this information (from answer to question 1)?

3. Inputs to Forecast Parts: What inputs should you consider when forecasting replacement part requirements?

4. Forecasting Accuracy Implications: Assume you have an 80% "Forecasting Accuracy" score on your Performance Evaluation Report during a simulation round. What are the effects of this 80% “Forecasting Accuracy” performance level?

EXERCISE #1: *ANSWERS*

1. You should start by looking at your **sales volume history**. What were your results? What was the size and variability (degree of change) of demand in each region for each product and channel? Do you see any trends? Do they appear to be long-term?

   Eventually, you should seek to predict **cause-and-effect relationships** between demand and the variables that impact it, variables like:
   - **Price** and
   - Customers' perceptions of your **product quality**, **service quality**, and **availability**.

   These variables relate to your firm's marketing and operational strategies. Of course, **competitors' actions** should also be anticipated. These generate demand variables, and the factors that influence them, are detailed in your LINKS manual.

2. Some information needs to be deduced from **experience** and your **reports**. For example, what happened when you increased price during the *last* simulation round? Would you get the same results *next* time, or do you expect conditions to change? What other variables influenced your sales?

   Spreadsheets that track decisions, results, and other information from round to round may also help you see trends. Other information could be obtained directly via **research studies** detailed in your LINKS participant's manual.

3. Replacement parts requirements are predominantly a function of estimated failure rates times historical sales through the warranty period. Failure rates vary by sub-assembly components supplier and by sub-assembly component.

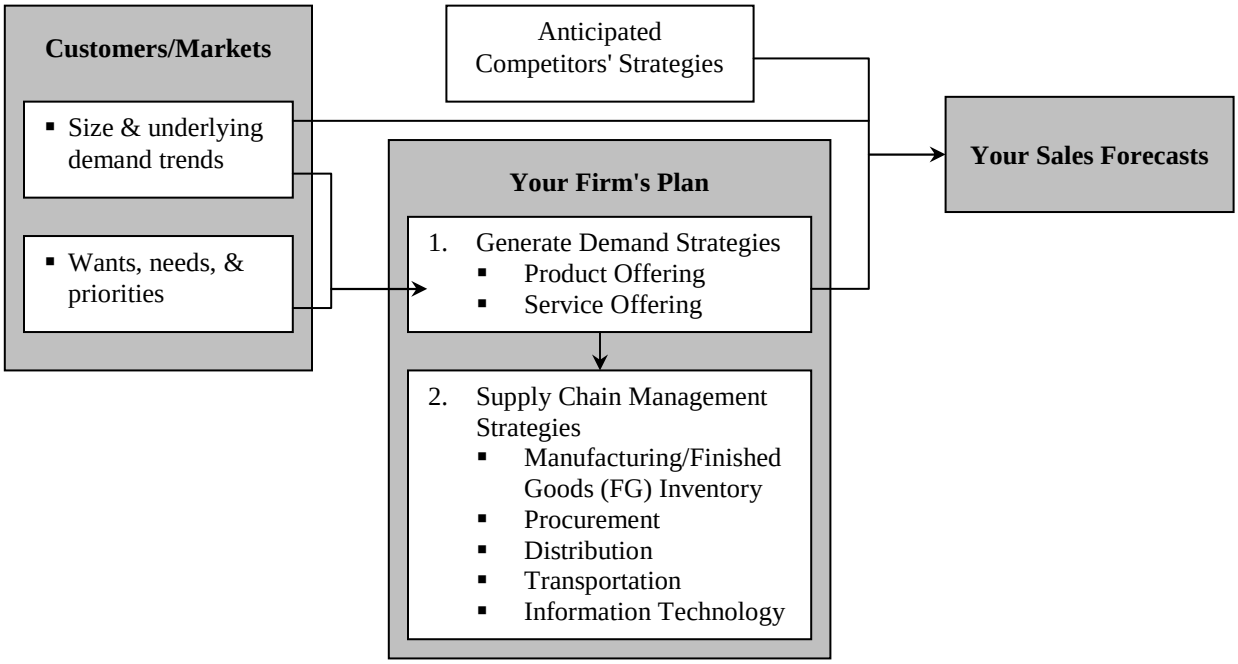
4. A direct result is an increase in "Administrative Overhead (O/H)" -- in this case, by 20% (a 1% O/H increase for every 1% inaccuracy). Other supply chain management areas are also adversely affected, such as inventory holdings.

2. How does sales forecasting relate to other supply chain management decisions?

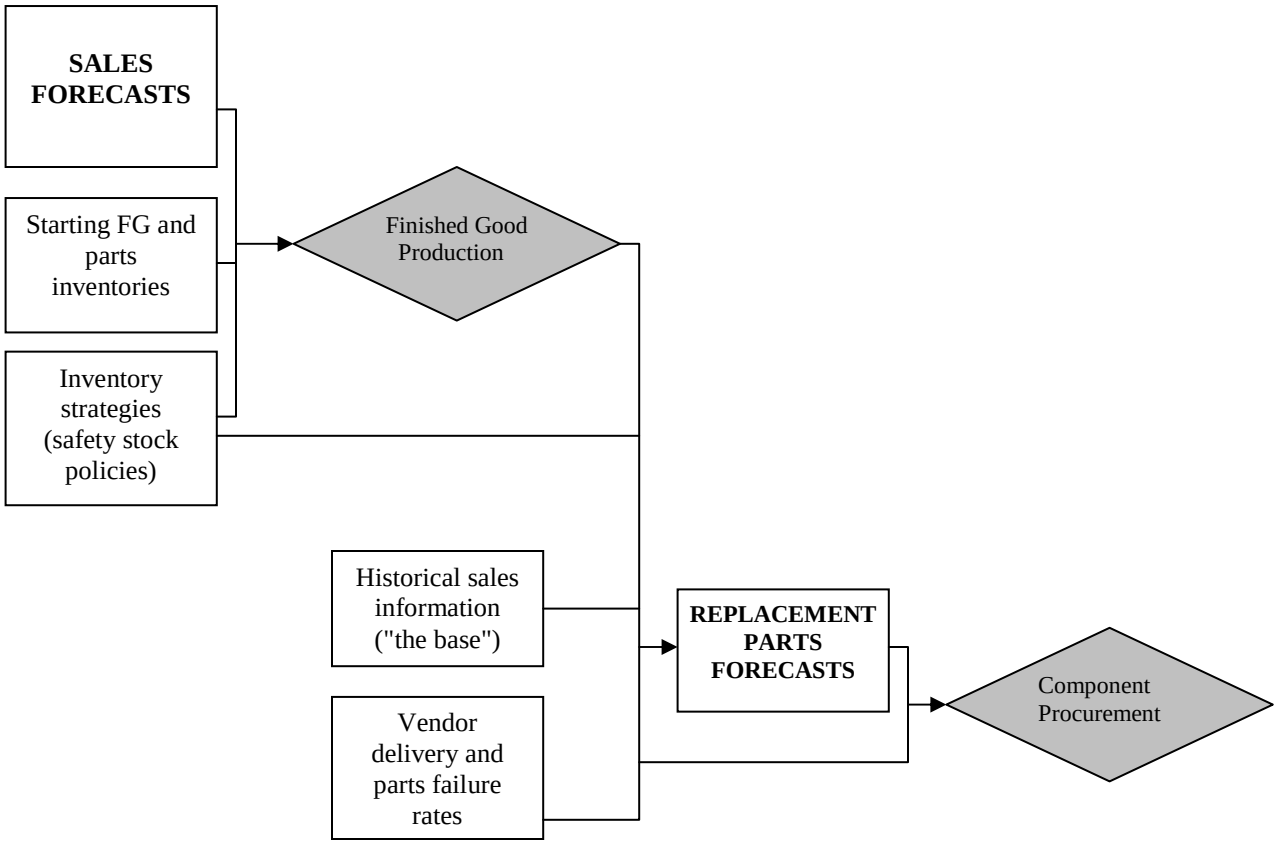
Each simulation round, you and your team need to discuss and develop **strategies** (broad courses of action) and decisions for each decision are in LINKS:

- Product Development
- Procurement
- Manufacturing
- Distribution
- Transportation
- Service
- Generate Demand
- Information Technology.

Ideally, **customers** should drive your generate demand strategies and the design of your entire supply chain. Generate demand strategies should also drive your **sales forecasts**:



Sales forecasts have implications for many other supply chain management decisions upstream (shaded diamond boxes, below):



Accurate sales forecasts enable all supply chain elements to work together as an integrated system, something critical to the success of your company. So what exactly *is* the impact of sales forecasting? Explore this by working through EXERCISE 2 - A LINKS Case.

EXERCISE #2: A LINKS Case

Please read the scenario about Firm Z's Region #3, and answer the questions that follow. Check your responses by referring to the answers starting on page 10.

SCENARIO: Firm Z just completed round 5. They currently sell both Products Z-1 and Z-2 in Region 3, both in channel 1 only. To date, Firm Z has made only three changes to its initial starting position decisions (as of round #3) in Region 3. They:

- Added a DC3 that they've owned and operated since round 4 (there was no DC3 to start). They added it to explore postponement and "see what happens."
- Reduced FG and parts inventories to absolute minimums to cut "unnecessary" costs.

All of the following have remained constant since round #1:

- Product configurations.
- Channels.
- Prices.
- Marketing budgets.

Recent *Set-Top Box Industry Bulletins* and some round #4 research has revealed that some competitors have:

- Opened channel 2 for both product lines.
- Reconfigured products.
- Changed prices and marketing budgets.

Here is an excerpt from one of Firm Z's spreadsheets that shows their sales results since round #1:

	Round #1		**Round #2**		**Round #3**		**Round #4**		**Round #5**	
	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual
Z-1	15,000	15,000	15,000	10,500	15,000	15,120	15,000	11,300	12,000	6,000
Z-2	6,600	6,600	6,600	4,620	6,600	6,930	6,600	5,300	5,400	3,300

Continued…

EXERCISE #2: *continued…*

Firm Z's forecasts were just slightly above round #4 actuals because they explained, "We're not making any generate demand changes in this region, so sales probably won't change much." They forecasted increases of 6% and 2% for Products Z-1 and Z-2, respectively. Other data from Firm Z's rounds #4 and #5 follow:

Original Manufacturing Cost:
Product Z-0, Round #5

Alpha	18.00
Beta	27.00
Production Cost	34.00
LaborCost	23.00
	102.00

DC3 FG Inventory:
Product Z-0, Round #5

Beginning Inventory	700
Plant Shipments, Surface	16,200

1. Costs of Underestimation: Assume that Firm Z ordered exactly the number of Z-1 and Z-2 products they forecasted for round #3 (15,000 and 6,600 units respectively). Assume that there were no finished goods inventories for either product at the start of round #3. What was the likely cost implication(s) of this underestimation?

2. Underlying Demand Patterns: Finish calculating the percentage changes in actual sales for both products in rounds #4 and #5 in the table below. What do you notice (if anything) about demand for each product?

	Round #1 Actuals	Round #2 Actuals	% Change	Round #3 Actuals	% Change	Round #4 Actuals	% Change	Round #5 Actuals	% Change
Z-1	15,000	10,500	-30%	15,120	+44%	11,300		6,000	
Z-2	6,600	4,620	-30%	6,930	+50%	5,300		3,300	

EXERCISE #2: *continued…*

3. Forecasting Assumptions: What appear to be the primary reasons for Firm Z's poor round #5 forecasting accuracy? Explain.

4. Safety Stock:
   a. How much Product Z-0 safety stock did Firm Z have in round #5?

   b. Was this a good decision? Explain.

5. Cost of Overestimating: Firm Z forecasts of unit sales were obviously too high in round #5. What was the cost impact of this poor forecasting from a DC3/Product Z-0 inventory standpoint? Assume a beginning inventory of 700 units and that 16,200 units arrive on-time (about a 93% on-time arrival rate) of the original DC3 Z-0 shipment order of 17,400 units. (Show your calculations.)

EXERCISE #2: *ANSWERS*

1. They had to pay a premium for emergency production and the emergency shipment of this production. If there wasn't enough procurement inventory on hand to accomplish this emergency production, they had to pay a premium for emergency procurement, too.

2. Round #3 to Round #4:
   Z-1: (11,300 - 15,120)/15,120 = -0.25 (actual sales were down 25%)
   Z-2: (5,300 - 6,930)/6,930 = -0.24 (actual sales were down 24%)
   Round #4 to Round #5:
   Z-1: (6,000 - 11,300)/11,300 = -0.47 (actual sales were down 47%)
   Z-2: (3,300 - 5,300)/5,300 = -0.38 (actual sales were down 38%)

   It appears that the demand for products Z-1 and Z-2 tends to vary together, and swings tend to be fairly large. Five rounds is a rather short time period, but if Firm Z continues to track this information, they may be able to discern predictable demand patterns. While no demand pattern is guaranteed to last forever, and no two channels can be guaranteed to be the same from region to region or industry to industry, the information may prove useful.

3. One reason appears to be their naïve assumption that their sales will be influenced only by their *own* generate demand strategies -- i.e., "We're not making any generate demand changes in this region, so sales probably won't change much." What about *competitors*? They also didn't appear to consider underlying variability in the demand patterns for this channel in this region. (That's what you calculated in question #1, above … the "variability" or round-to-round changes in "pure" demand in the first three rounds of the simulation when all firms made the same decisions -- i.e., no generate demand strategy variation between firms).

4. a. None. They forecasted that they'd sell 17,400 total units in Region 3, and the *DC3 FG Inventory: Product Z-0, Round #5 Report* shows they had only 16,900 Product Z-0's on hand, that's 500 fewer units than they needed to meet their round #5 sales forecasts. This also indicates that Firm Z forgot that surface shipments do not necessarily have 100% of the order available for use in that round, meaning those 500 units they needed were probably part of a "delayed shipment" they received *after* production at the end of the round.

   b. In hindsight, probably yes because they sold so much fewer than they expected. Their ending inventories would have been even higher. Given the apparent variability of demand in this channel in this region, however, they could probably benefit by considering higher safety stock levels in the future when their understanding of generate demand strategies, competitors, and forecasting improves.

EXERCISE #2: *ANSWERS, continued…*

5. (1) First, calculate Region 3's ending inventory of Product Z-0 for round #5:

	Beginning Inventory	700	
+	Plant Shipments, Surface	16,200	
+	Plant Shipments, Air	0	
+	Plant Shipments, Emergency	0	
	Postponed Production	-9,300	
=	Available Inventory	7,600	
-	Sales, Region 3:	0	
+	Plant Shipments, Delayed	1,200	(17,400 ordered - 16,200)
=	Ending Inventory	8,800	

(2) Calculate the inventory value = 8,800 x $102/unit = $897,600
Plus a 3% carrying cost = $897,600 x 1.03 = **$924,528**

That's a **carrying cost of $26,928** ($924,528 - $897,600) that was caused by Firm Z's poor forecasts. And that $26,928 and the inventory stored is cash that Firm Z could not use for other value-producing uses in round #5.

To put this waste into perspective, consider that the carrying cost of $26,928 was:

- $5,486 (roughly 25%) more than they paid for service in Region 3 in round #5.
- Twice their <u>total</u> Region #3 replacement parts cost in round #5.
- 25% of their Region #3 marketing budget.

Put that way, their round #5 carrying cost was one big chunk of change, and one good reason to improve their forecasting!