System Dynamics Group
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Introduction to System Dynamics, 15.871
System Dynamics for Business Policy, 15.874
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Assignment 4
Competitive Analysis Using System Dynamics

Assigned: 2 October 2003; Due: 9 October 2003
Please work on this assignment in a group totaling three people.

In the past fifteen years, managers, strategy scholars and economists have discovered the notion of positive feedback. Under such headings as increasing returns and network externalities, a variety of strategic frameworks and theories now recognize the importance of positive feedback loops in creating growth and conferring competitive advantage. Unfortunately, these frameworks, while suggestive, often are not sufficiently operational to help managers make strategic decisions. An important manifestation of this difficulty is the focus, particularly among so-called "New Economy" companies, on the "GBF" (Get Big Fast) strategy. Often, such firms (and their backers) assume that size confers competitive advantage without a particularly clear idea of which processes actually link size to success. The recent failure of many companies that pursued the GBF strategies is testament to the fact that successfully exploiting positive feedback for strategic advantage requires careful consideration of where such processes exist and where they don't. This assignment gives you the opportunity to use your system dynamics skills to analyze competitive dynamics and formulate strategy.

Before attempting this assignment, be sure to read the relevant sections of *Business Dynamics*, specifically, Chapter 10 (particularly sections 10.1, 10.3, 10.4, 10.5, 10.6, and 10.7).

A. Pick an organization and a market

Begin by choosing an organization to be the subject of your analysis. The point of this assignment is **not** to have you spend time collecting data, so choose an organization with which you are familiar and/or interested. Feel free to use whatever knowledge you may have to inform your analysis. Do not to restrict yourself to new technologies or high-growth markets (although these could be excellent choices). You also need not restrict your attention to for-profit concerns. Social programs, government initiatives, and not-for-profit organizations could also be good choices.

B. Develop a Stock, Flow and Feedback Diagram

Using the tools we have developed in class (see also section 10.4 in *Business Dynamics*), develop a diagram that capture the important feedbacks driving growth in your chosen organization. Highlight the stock and flow structure only where it reveals important details not otherwise captured by the causal diagram. Do not attempt to draw every possible feedback structure, but instead only those that you feel are particularly important. Be very careful to distinguish between feedbacks that increase demand in the *industry* and feedbacks that increase your chosen firm's share of that demand. You may find it useful to have two or three smaller diagrams rather than one big complicated one. You may wish to consider issues such as the role of proprietary versus open standards, returns to scale and scope, learning from production experience and from user experience, and market power conferred by relative size. To get started, you may find it useful to

begin with the loops highlighted in section 10.4 of *Business Dynamics*, asking for each set, "are these dynamics important for my organization and industry?" Do not, however, limit yourself to these loops; there are quite possibly others of potential importance to your case.

C. Assess the Determinants of Product Attractiveness

Your causal diagram should include both the feedbacks showing how potential customers become aware of your organization's offerings and those affecting the attractiveness of the product or service you are modeling. It should also show how the attractiveness of your firm's offerings affect both market share and total industry demand. You will probably identify a number of different product attributes that jointly determine attractiveness. For each factor affecting attractiveness, make a sketch showing qualitatively how you believe the attractiveness of your chosen product or service depends on each factor. Your graphs should show the qualitative shape of the relationship, including any relevant nonlinearities. You can include approximate quantitative information if you can estimate it quickly from the information at hand. Be sure to clearly identify the input to each factor.

On each graph, show approximately where you think your organization is operating at the moment. Also show where you think the competitors are operating (as an aggregate—it is not necessary, for this assignment, to show each competitor individually, though you would seek to do so in an actual competitive analysis). To illustrate, suppose you were modeling Sloan's cafeteria, the Refresher Course. You identify price, food quality, and waiting time as the significant determinants of product attractiveness (you could include others, such as cleanliness, variety, and friendliness of the service staff, but for illustration consider only these three). The diagrams on the next page illustrate how these determinants of attractiveness might depend on price, quality, and waiting time, and provide the type of explanation we seek. Note: These diagrams are meant to illustrate the process we want you to follow and are not based on actual data.

Note that each graph is clearly labeled. Note also that the inputs are made operational (in particular, note the input for the effect of waiting time on attractiveness). Finally, note that the curves tend to be smooth, without sharp discontinuities. The curves are smooth even in those cases where the description of the relationship involves a threshold, as for example the threshold level of quality below which the food is so unattractive you would not choose to eat there no matter how cheap the food or quick the service. The curves shown describe the aggregate, or average, over the potential market. Since different people have different preferences (different quality thresholds), the aggregate curve will be smooth even if each individual's curve has a sharp discontinuity.

Note also that the relative slopes of the effects matter. As shown, the sensitivity of attractiveness at the current operating point (around the region identified as characterizing the current product offering) is steepest for wait time and flattest for price. This indicates that, at least in the neighborhood of the current offering, customers care most about wait time, then quality, and least about price. Of course, your individual preferences may differ from these assessments, and, more to the point, you may believe that the relative rankings for the aggregate customer base should differ from those implied by the slopes of the curves. Such disagreements are common and can be addressed through market research. What is important for your analysis is to consider which of the factors is most important (in the region the firm is operating) and to offer at least some data or hypotheses to justify your choice. You should provide a list of the factors affecting attractiveness ordered from most to least influential (at the current operating point).

In a more sophisticated model you may choose to disaggregate the total potential market into different types of customers, with each type having a distinct set of preferences (different set of curves). For example, you might distinguish between the price-conscious consumer on a tight budget (those willing to put up with longer waits and lower quality to get a low price) and time-conscious people (willing to pay more for quick service). Such segmentation, while often important in real world applications, is **not** necessary for this assignment.

Effect of Price on Attractiveness

Refresher Course

Competition

$$\dfrac{\text{Price}}{\text{Reference Price}}$$
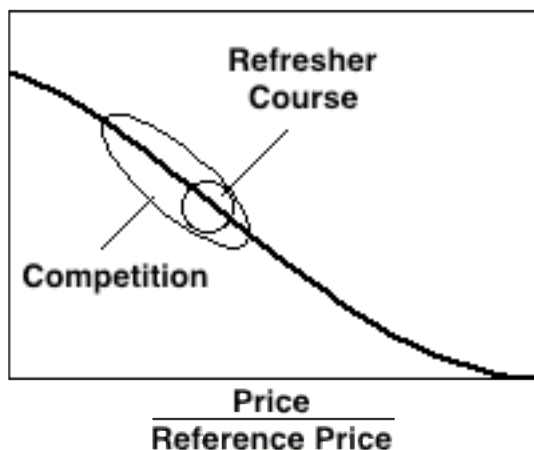
Attractiveness falls as price increases. For very high prices, demand falls to zero, but at a diminishing rate—some customers are willing to pay a lot for the convenience of the Refresher Course. At the other extreme of very low prices, the relationship flattens as well, indicating that even very low prices don't overwhelm the other factors that affect attractiveness. Current prices are shown as moderate, towards the higher end of the range of competitor offerings in the Kendall Square area. Reductions in price would have only a moderate impact on attractiveness.

Effect of Quality on Attractiveness

Competition

Refresher Course

$$\dfrac{\text{Food Quality}}{\text{Acceptable Quality}}$$
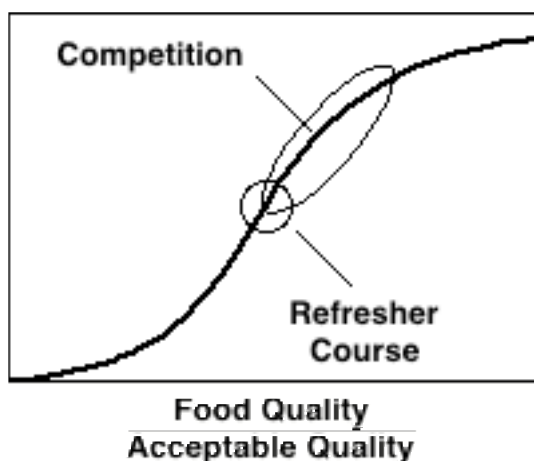
Attractiveness rises with food quality. The relationship is s-shaped. At the low end, there is some minimal level of quality people require, so that quality above zero is still so poor that most people would find the product quite unattractive. Above the threshold, attractiveness rises sharply with increasing quality, but saturates for very high quality levels—students don't require or value Michelin 3-star quality food for their morning coffee or the sandwich they wolf down between classes. Current quality is shown as medium, and at the lower end of the range of competitive offerings in the Kendall Square area. The implication is that a small increase in quality would have a large impact on attractiveness.

Effect of Wait Time on Attractiveness

Competition

Refresher Course

$$\dfrac{\text{Average Peak Hour Wait Time}}{\text{Acceptable Wait Time}}$$
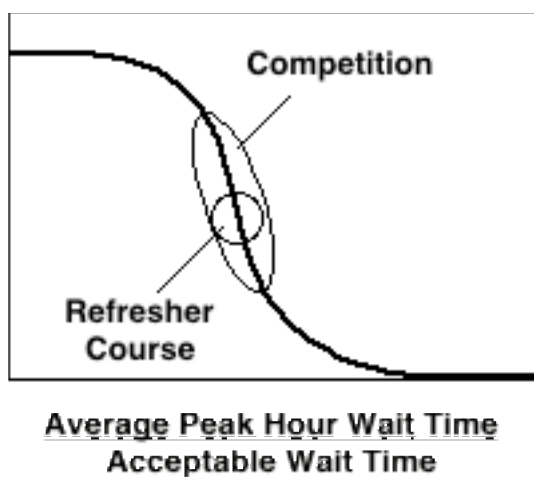
Attractiveness falls with increasing wait time. Note that the input to this factor of attractiveness is average (or expected) wait time during peak hours. Peak hour wait time is the relevant factor, not average overall wait time, for two reasons. First, most customers, by definition, come during the peak times. Second, the average wait in non-peak times is short. What customers care about is being able to get their food quickly so as not to be late for the next class or meeting. The relationship is sharply nonlinear. Below some threshold, the wait time is sufficiently short that attractiveness does not rise further with even shorter waits. Beyond the threshold there is a steep drop in attractiveness, until the wait time is so long that the service is seen as unacceptable. Average peak wait time is shown as moderate, with some competitors offering faster service (e.g. ABP, food truck) and some offering slower service (Legal Sea Foods). Reductions in peak wait time would have a large impact on attractiveness.

As a final note, observe that the inputs to each graph are normalized by a reference value: The horizontal axis is, for example, Peak Wait Time/Acceptable Wait Time, not the raw wait time itself. Normalization is important because (1) knowing the wait time alone doesn't indicate whether attractiveness would be high or low—wait time is only meaningful relative to the standard or acceptable wait time; (2) normalizing means each graph is on a comparable scale so the relative slopes are comparable. Therefore the steepest curve is the most important input to attractiveness, and the flattest the least important. Include appropriate reference values in your graphs.

D. Assess the Current Strategies

Using your analysis of the industry's competitive dynamics and your firm's position relative to the factors of attractiveness, assess the quality of your chosen organization's strategy. Four questions may help guide your analysis.

1. Does a particular strategy strengthen one or more of the important feedback processes driving industry demand and market share?

2. Are those gains *appropriable*? That is, if your firm successfully generates growth in the industry via one or more positive feedback processes, how successful will it be in keeping most of that increase for itself?

3. If the gains are *currently* appropriable, how vulnerable are they? That is, what balancing feedbacks might be stimulated by the success of your firm and ultimately limit your market share or profitability? Consider vulnerability to the entry of new competitors, changes in supplier or customer power, changes in technologies, and other potential balancing feedbacks.

4. What are the balancing loops that will ultimately limit growth for the market or industry as a whole?

E. Prepare a Report on Your Analysis

Having completed the above, write up your analysis in the form of a short report. Assume that your audience is familiar with the tools of system dynamics, so don't spend time explaining the basics. Focus on the substance. Limit your report to **4 double-spaced pages** (1-inch margins, 12-point type). The page limit does not include figures, which should be attached to your assignment on separate sheets of paper. Briefly describe your diagrams and explain how they capture the competitive dynamics of your chosen firm and industry. Discuss your analysis of the firm's strategy. Be particularly careful to include and justify your final assessment of whether or not its current approach will be successful. Prepare a set of recommendations detailing how your chosen organization's strategy could be modified to take better advantage of the industry's current structure and to be more robust to changes in the market and technology.

Finally, suppose you had a limited budget for additional market research or empirical work. Where would you spend it? In particular, identify the three relationships or links in your framework you would most like to estimate better. Explain briefly (in at most a short paragraph).

You should select relationships that are *both* highly uncertain *and* likely to matter to the outcome. Obviously, a relationship that is influential but for which there is no significant uncertainty need not be investigated further (but beware: most of the time we are more confident in our judgments than we should be and underestimate the uncertainty we face—see section 8.2.5, pp. 272-274, for discussion). Conversely, if a relationship is uncertain, but your analysis suggests it is part of a feedback process that is not important to the success of your strategy, then there is no point in spending time and money to specify it more accurately: high uncertainty doesn't affect the outcome. You should focus your time and budget on those factors that are both high-leverage and uncertain.