# CREATE AND RUN YOUR OWN NEWSPAPER:

# A JOURNALISM UNIT WITH A SIMULATION GAME

## Part 3: Examine the Model

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## INTRODUCTION

In this paper, students and teachers can take a closer look at the system dynamics model underlying the management flight simulator game in "Create and Run Your Own Newspaper, A Journalism Unit with a Simulation Game" by Dan Barcan, Leah Zuckerman, Gary Hirsch and Debra Lyneis. There is a brief explanation of the model in simple terms, followed by a series of activities using the model as a laboratory. The activities lead to a deeper understanding of the game model, the newspaper system, and system dynamics.

The activities in this paper are more challenging than those in the previous paper. They are appropriate for middle school students with some background in system dynamics, high school students, and teachers who want to learn more about system dynamics.

## "CREATE AND RUN YOUR OWN NEWSPAPER"

This paper is Part 3 of the unit, "Create and Run Your Own Newspaper: A Journalism Unit with a Simulation Game," by Barcan, Zuckerman, Hirsch and Lyneis. To briefly summarize the rest:

- In Part 1, students complete a series of activities to write and paste up their own newspapers in class.
- In Part 2, students play a simulation game to run their own newspaper businesses using a system dynamics model. The model is a management flight simulator written with the help of Gary Hirsch, a professional system dynamicist from Wayland, MA who uses modeling in his management consulting business.
- Using a system dynamics model focuses attention on the core of the journalism unit: What is a successful newspaper? Students must decide how to produce a quality paper that people will actually buy and read.
- In playing the game, students learn about feedback as they experience the consequences of their decisions in a complex system. They discuss feedback loops in debriefing after the game.
- The journalism unit was developed at the Murdoch Middle School, Public Charter School of Chelmsford, MA. The school has a project-based, learner-centered curriculum with system dynamics written into its charter.
- Part 1 and Part 2 of "Create and Run Your Own Newspaper," including the model, are available free on-line from the Creative Learning Exchange at http://www.clexchange.org or http://sysdyn.mit.edu/cle. The model was built using STELLA 5.0, Authoring Version, by High Performance Systems, 45 Lyme Road, Suite 300, Hanover, NH 03755. It will also run on the STELLA Run-Time Demo 5.1.1 version that can be downloaded for free from High Performance Systems at http://www.hps-inc.com.

## USING THE NEWSPAPER MODEL TO DEEPEN UNDERSTANDING

Students who have played the newspaper game have gained a good sense of the newspaper system. They know that their decisions have consequences. However, they also know that because the system is complex, they cannot reliably predict just what those consequences will be. With practice, they have developed a general understanding of the feedback processes at work, and they have tried to manage them.

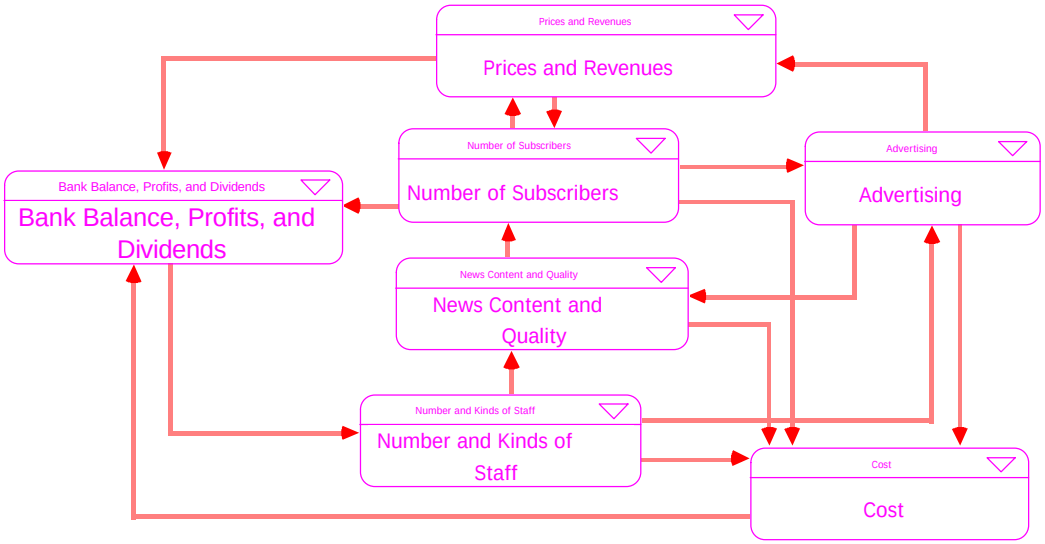
Now that students have experienced *how* the newspaper system behaves, they are ready to take a closer look at the model itself to understand *why*. First, students can look at the model flow diagram. After exploring the model, students can then use it as a laboratory to investigate what happens if they change different variables.

## A CLOSER LOOK AT THE MODEL

Use this brief description to acquaint yourself with the basic workings of the model. Then lead students through a similar discussion.

Open the model labeled "Newspaper." The original model is locked to prevent players from making changes to the model itself. You can **unlock the model** and gain access to all of the equations and dialog boxes by going to the "File" menu and clicking on "Security." Enter the password "newspaper" and check "Full access." (You may want to preserve a clean copy before you give students an unlocked model, however!)

When you open the model, you will see an **Overview** screen. This is a simplified "map" of the newspaper system. It is also the home base for game navigation.



The large pink rectangles on the overview screen are **sectors.** The sectors make the model easier to understand by grouping together functionally related variables. The arrows connecting them indicate causal relationships between these main elements of the model. For example, the news content and quality of a paper affect the number of subscribers, and the number of subscribers affects the bank balance. The overview map gives you a very general view of the model and prepares you for a more detailed look at the complete model that underlies it.

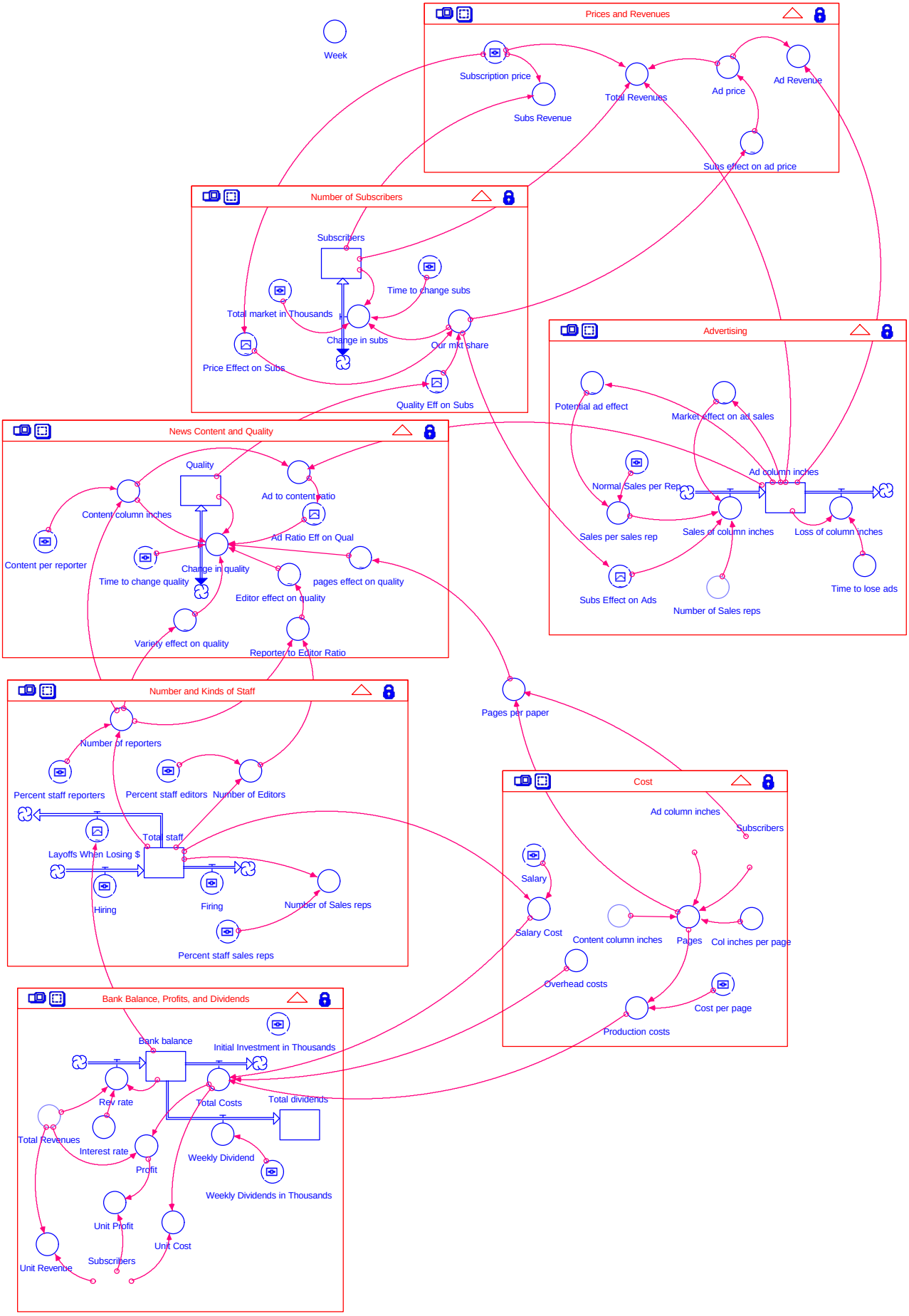
To view the full model, click on the downward arrow in the small gray box in the upper left corner of the screen. You will see the **model flow diagram**, but because it is large you will need to scroll up and down and from side to side to view all of it. The sectors are shown in more detail as are the many arrows connecting them.

Do not be intimidated by the size of the model! It may appear large and elaborate, but it is actually based on a set of very simple **common-sense assumptions**. These assumptions were stated in the game instructions for students in "Create and Run Your own Newspaper: A Journalism Unit with a Simulation Game," and are repeated here:

- Your **bank balance** shows how much money your business has. You earn money from subscriptions and ad sales. You spend money on **salaries, production costs**, and **dividends** (the money you keep for yourself).
- Your **subscribers** are the people who buy and read your paper. The model assumes that if you have a quality paper at a good price, more people will buy it. (Subscribers can also leave if the quality is bad or the price is too high.)
- **Advertising salespeople** sell ads, which bring in money. Each salesperson sells a certain number of **ad column inches**. You pay them salaries.
- **Reporters** write the stories (the content of your paper). Each reporter writes a certain number of **content column inches.** The content determines the **quality** of your paper. Each reporter earns a salary.
- **Editors** manage the paper and improve the quality. They also earn salaries.
- You can **hire** and **fire** workers; this will affect your quality and your costs.

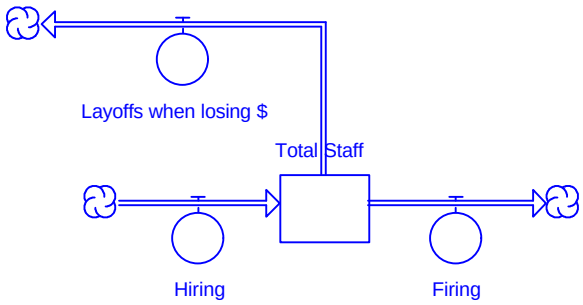
With a system dynamics model, you can take these basic assumptions and make them explicit. View the model diagram as just a more detailed picture of the relationships described above. There is nothing mysterious in the model assumptions. Each equation simply expresses a common-sense causal relationship between the two connected elements of the model. Give yourself a chance to explore the model and you will see how its pieces fit together. It is a web of common everyday assumptions. It is just elaborate enough to reflect the real-world complexity of the newspaper system and to respond realistically when players make decisions running their simulated businesses.

The complete model flow diagram is on the following page.


Week
Prices and Revenues
Subscription price
Subs Revenue
Total Revenues
Ad price
Ad Revenue
Subs effect on ad price
Number of Subscribers
Subscribers
Time to change subs
Total market in Thousands
Change in subs
Our mkt share
Price Effect on Subs
Quality Eff on Subs
Advertising
Potential ad effect
Market effect on ad sales
Normal Sales per Rep
Ad column inches
Sales per sales rep
Sales of column inches
Loss of column inches
Subs Effect on Ads
Number of Sales reps
Time to lose ads
News Content and Quality
Quality
Ad to content ratio
Content column inches
Content per reporter
Ad Ratio Eff on Qual
Time to change quality
Change in quality
pages effect on quality
Editor effect on quality
Variety effect on quality
Reporter to Editor Ratio
Pages per paper
Number and Kinds of Staff
Number of reporters
Percent staff reporters
Percent staff editors
Number of Editors
Total staff
Layoffs When Losing $
Hiring
Firing
Number of Sales reps
Percent staff sales reps
Cost
Ad column inches
Subscribers
Salary
Salary Cost
Content column inches
Pages
Col inches per page
Overhead costs
Cost per page
Production costs
Bank Balance, Profits, and Dividends
Bank balance
Initial Investment in Thousands
Rev rate
Total Costs
Total dividends
Total Revenues
Interest rate
Profit
Weekly Dividend
Weekly Dividends in Thousands
Unit Profit
Unit Cost
Unit Revenue
Subscribers

Notice that the model has six **stocks** (rectangles): Subscribers, Ad Column Inches, Quality, Total Staff, Bank Balance, and Dividends. These are all accumulations, or measurable quantities that can build up or drain over time. If you could take a "snapshot" of the newspaper system at any point in time, you would see the contents of these stocks, and they would describe the condition of the system at that moment. At that point in time, your newspaper would have a certain amount of money in the bank, a certain number of subscribers, a certain level of quality, a staff, and so on.

Connected to each stock are its **flows**. They look like pipes with valves. The flows determine how the stocks increase or decrease over time. For example, the Total Staff stock is increased by Hiring and decreased by Firing (your decisions) and Layoffs (which happen automatically when your bank balance goes negative). The only way a stock can change is through its flows. The total staff is a number of people; each week that number changes as the number of new people hired flows in and the number of people leaving flows out. Each week, the number hired is added and the number leaving is subtracted from the previous number of staff people.




All of the other circles and arrows on the diagram provide information used to compute the flows. For example, Bank Balance is decreased by Costs, which include Salary Costs, Overhead Costs, and Production Costs. You'll notice that there are many interconnections, however, because the parts of the system are all interdependent. For example, production costs depend on the number of subscribers and the number of ad column inches sold, which in turn depend on other variables, and so on. You can trace the arrows to read the "stories" of these relationships. The circles on the diagram are called "**converters**."

The model flow diagram presents a detailed "map" or visual representation of the system. From it you can tell what causes what and see the web of interdependencies throughout the system. To understand precisely how each variable influences the next, however, you need to look at the **equations** underlying the flow diagram. First, check that there is an $x^2$ in the upper left side of the screen. (If there is a globe icon, click on it to switch it to the math icon, $x^2$.) Now you can either view one equation at a time by clicking directly on the variable on the flow diagram, or you can view them all at once by clicking on the downward arrow in the upper left corner. It is probably less intimidating to just select a few that interest you and look at those. For example, the Total Revenue equals the Ad Price times the number of Ad Column Inches, plus the Subscription Price times the number of Subscribers (divided by 52 to get a weekly subscription value.) Look at a few more and figure them out.

One more explanation will help you read and understand the model. Notice that there are several converters called "Effect of…" (On the flow diagram, these converters have squiggly lines in them.) These are called **graphic functions** and they use graphs rather than equations to describe the relationship between two variables. They can capture a complex non-linear relationship without sophisticated math equations.

Click on the graphic function converters to read the graphs. For example, "Ad Ratio Effect on Quality" says that as you increase the proportion of ads in your paper, the quality declines: Nobody likes a newspaper that is all ads. Another example is "Price Effect." This graph says that as the price gets higher you lose subscribers, especially rapidly at very high prices. A final example is "Market Effect on Ad Sales." This graph describes market saturation: When you have sold all the possible ads in your area, you cannot sell any more. The values produced by these graphic functions are then multiplied into subsequent equations, so that, for example, the "Sales of Ad column Inches" is increased or decreased by the size of the "Market Effect on Ad Sales." These relationships are very important to the functioning of the system and are worth examining. (They can also be changed if you dispute their underlying assumptions.)

If you read the equations and graphic functions, you will understand all of the individual causal relationships that make up the model fabric. You will not be able to tell just by looking how the complete system will behave, however, because the system is just too complex. The human mind cannot grasp and compute all of the interrelationships at once. Fortunately, this is an easy job for the computer! When you run the model, the computer calculates all of the equations over and over again to **simulate** the system's behavior over time. Starting with the initial stock conditions, it calculates the flows and uses those flows to calculate the values of the stocks; then, based on the new stock values, it calculates the flows again and uses the new flow values to calculate the new stock values, over and over again.

You read the **output** from a simulation run on **behavior over time graphs**. In the game, students primarily looked at the Overview graph on the "Results" screen. That graph displays values for Bank Balance, Subscribers, Ad Column Inches, and Content Column Inches. Now that you have taken a closer look at the model and know that many variables are involved in the system, you may want to examine graphs of those other variables. In a model as complex as this one, with everything constantly changing in relationship to everything else, it is important to look at many variables to more fully understand and influence the behavior of the system.

There are several ways to view graphs of other variables in the model. On the Results screen, you can see other pages of the main graph pad by clicking on the small white triangle on the bottom left of the graph. Below the main graph pad there is also a comparative graph with many pages. The comparative graphs save the results of previous runs so that you can compare them. Finally, on the Overview screen, the small blue boxes scattered within the map are links to graphs that provide more information about each sector. All of the graphs are updated with every run of the model.

That concludes your quick tour of the model! Now you can play the game again, understanding a little bit more about the model itself, and appreciating some of the complexity of the real-world newspaper system that the model replicates. In system dynamics, the best way to learn is by doing. Take a little while to explore the model, play with it, and learn from it. There are many good lessons imbedded in this elegant "little" model--about system dynamics and about the newspaper system.

## TESTING YOUR STRATEGY

After the students have played at least three rounds of the game and discussed causal loops in their debriefing (as discussed in the previous paper) ask them to identify their most successful strategy for testing. The purpose of the testing is to see how well a strategy stands up to various changes in conditions. Once you find a way to run a successful business, you want to keep it running successfully. To do this, you need to identify your vulnerable spots to avoid future problems. Which changes in conditions make a difference and which ones do not matter? What are the important variables that you need to track and manage?

After system dynamists build a model, they use it to answer questions like these. Businesses collect and analyze tons of information for strategic planning, yet most of what they collect may be of little real use for effective planning. A system dynamics model, however, can identify the leverage points, important variables that influence the behavior of the system. Often these leverage points are not the ones you would intuitively expect. This finding does not apply only to business systems, of course. It applies to complex systems all around us and speaks to the broader utility of system dynamics models to address all sorts of problems.

Written instructions for testing your newspaper business strategies are included on the model. From the Overview screen, click on Testing to read the text of the instructions on the screen itself. The instructions are also reproduced below.

Note: In the previous paper, we gave you the "secret" to a successful business. You need to slowly build a solid subscriber base by providing a high quality paper before you can build revenue by adding more advertising. You can achieve this by adding approximately one employee a week with a distribution of approximately 10% editors, 60% reporters, and 30% ad salespeople. See how close any of the teams of students came to this. They do not need to test this exact policy, though. They should test their own and make changes as they find improvements.

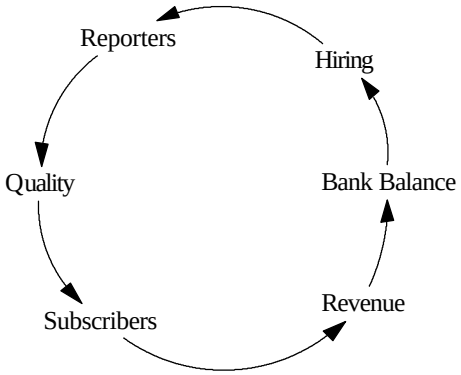
**TEXT FROM THE MODEL: "TESTING YOUR STRATEGY"**

> Once you have a strategy you are happy with, you can get a better understanding of the newspaper business by testing that strategy with different assumptions. This is sometimes called "sensitivity testing" or "torture testing". For example, if the reporters you hire aren't very good and only write a page of stories per week instead of a page-and-a-half, will the strategy still be successful? Or, if reporters and other staff got paid $800 per week instead of $500, would there be enough money to successfully launch the newspaper? How would your strategy have to change to deal with these differences?
>
> The testing section has a number of "sliders" and graphical input devices that let you pose these kinds of questions. For example, moving the slider for "Content per Reporter" from 180, its initial setting, to 120 would allow you to analyze what would happen if your reporters were less productive than you might hope. You would run through a simulation, setting your decisions, pressing the Run button to move from one 13 week period to the next, and observing the effect that lower Content per Reporter would have. You can also make several changes in combination to see their combined effect.
>
> When you click on any of the graphical input devices, you can make changes by shifting the curves in the dialog boxes that appear. For example, the first curve is the relationship between subscriber market share and the ability to get advertising. If you "bend" the curve downward toward the x-axis, you are changing the relationship to make it harder to attract ads as the subscriber market share grows.
>
> You can do this testing by moving through simulations in 13-week intervals or set your changes and decisions and simulate an entire 2-year (104-week) interval at once. To make this change, press the Time Interval button at the top of the Testing section and change the Pause Interval to 104.

**OUTCOMES: MORE LOOPS**

Follow the instructions and just play with the model to see what you can find out. Again, look at many of the graphs to understand how many things are changing over time and influencing one another. On the screen below the main Results graph pad, there is another pad of comparative graphs. Use these to compare the effects of incremental changes in one variable, or the effects of changes in different variables. The idea is to determine which changes make a significant difference to the success of your business. Using the model as a laboratory, you will gain a deeper familiarity with the workings of the newspaper system and the feedback loops that control it.

As you play with the model, refer back to the feedback loops drawn during the game debriefing session. In general, you will find that trying to stoke growth by fueling elements of the positive growth loops may improve things for a little while, but that growth always hits limits. For example, you can boost revenues by hiring lots of ad salespeople, but you also have to pay them salaries. If you become stretched too thin and your bank balance dips below zero, employees will be laid off, possibly causing a downward spiral. Try to think of the system in terms of feedback loops, growth and limiting structures.

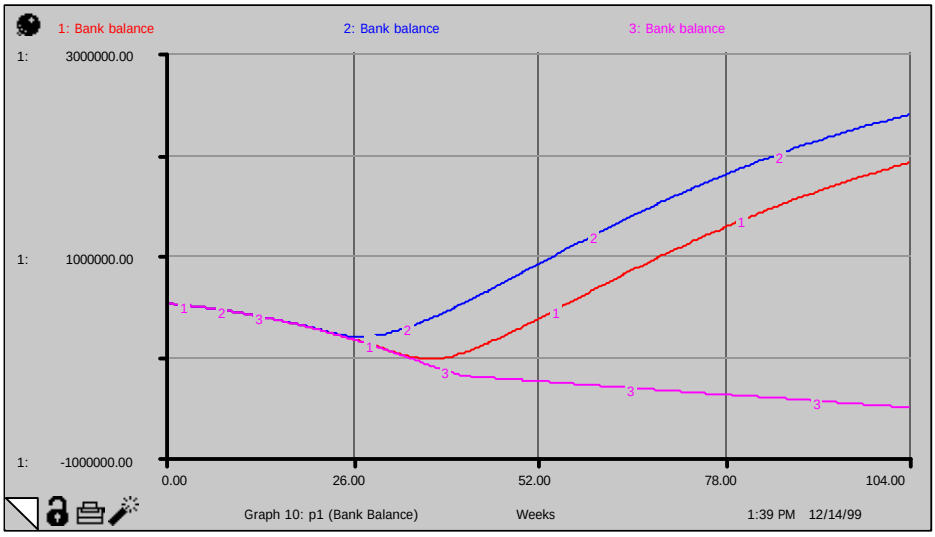



For example, Loop 1, reproduced here from the game debriefing session, is a positive growth loop. It says that the better the quality of your paper, the more subscribers you will gain, thus increasing your revenue. With more money in the bank, you can hire more reporters which will further improve the quality of your paper, and so on. Any change reinforces itself around the loop.

How can you exert influence on this loop? The quality of your paper is determined by the amount of editorial content produced by your reporters. If you could increase the content per reporter from 180 to 280 column inches a week, for example, you would be making this positive loop *stronger*. On the other hand, if your content per reporter fell from 180 to 80 column inches a week, the positive loop would be made *weaker*. Although you could not test such drastic changes on a real newspaper, you can try it on the model using the "Content per Reporter" slider on the Testing screen.

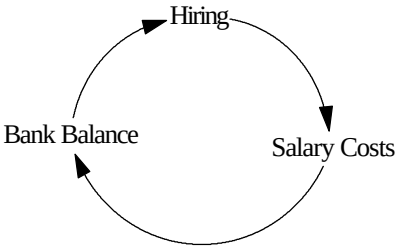
The comparative graph on the next page shows the results. Line 1 shows the bank balance with the original 180 column inches per week per reporter. With the reporters' output increased to 280 column inches for Line 2, the bank balance rises sooner and somewhat higher. However, if reporters produce only 80 column inches, for Line 3, the bank balance falls below 0 and the business spirals downward. With lower quality, there are fewer subscribers and not enough revenue to cover expenses, further reducing quality and the number of subscribers. The positive loop is still reinforcing, but it is now reinforcing in a downward direction.

When the positive loop has a *negative gain*, the business declines, as each time around the loop the bank balance drops. The loop has a *positive gain* when each pass around the loop builds the bank balance and the business grows. In your business, you would want to support the positive gain and avoid the shift to a negative spiral.




By drastically increasing your reporters' content from 180 to 280 column inches per week (if you could even do that!), you have certainly tried to beef up the positive growth loop. Yet the graph does not show commensurate increases in the bank balance. The bank balance in Line 2 does begin to increase sooner and it is somewhat higher than the base run in Line 1, but it does not continue to spiral upward as you would hope. Why?

The answer lies in another loop, a balancing loop that limits the growth loop. Take a look at Loop 3 from the game debriefing reproduced below. This loop says that whenever you hire more workers, you also increase your expenses for salaries, thereby strengthening the balancing loop through the bank balance, leaving fewer dollars for more hiring. (The other limiting loops also come into play. More subscribers mean higher production costs that need to be carefully managed, for example.)




Follow this example as you poke around the model. Give yourself the time to uncover its lessons. The idea is to use the model as a laboratory to understand the effects of the feedback loops in this system and carry that understanding to your thinking about other systems.

## YOUR FEEDBACK

We welcome your feedback on this unit. Please send us comments and suggestions for improvement through the Creative Learning Exchange at LyneisD@clexchange.org. Thank you.