

Living Business Models with System Dynamics: **Fast, effective, reliable and useful!**

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Get these slides sdl.re/tec2slides

This *slide-set* supports the workshop on “Agile SD” (Agile system dynamics).

‘Agile’ is a style of model-development in which a working, quantified model is built quickly, and with continuous involvement of the users or clients. It takes its name from an equivalent fast-development approach for IT systems.

There is no qualitative, causal-loop mapping or diagrams in this process, and the model continually delivers insight and actionable findings to the users.

See sdl.re/AgileSD for further explanation

The key message ...

Simulating business systems and performance was difficult

... but better *method* and *tools* now make it practical

... *easier, faster, more reliable* than complex, limited spreadsheets



Live, working, quantified business models

... to *design* the system so it *can* perform well

... and *manage* the system, continually, so it *does* perform well



Go to www.Sysdea.com

Click **Try Now For Free** and create an account (*free for 1 month: then models are retained and can be re-activated*)

Full video User Guide play-list at sdl.re/sygfull ... also accessible, with a PDF Guide, from the software itself

The screenshot shows a web browser window with the Sysdea website. The browser's address bar shows the URL <https://sysdea.com/>. The website has a green header with the Sysdea logo and the tagline "Modern online modeling software". A "Go to App" button is visible in the top right corner of the header. Below the header, the main content area features the heading "Think Forward, Think Clearly" followed by a paragraph of text: "Whether your bank account, the customers of a restaurant, or the trees in the rainforest, the world is driven by the changes of things over time. Sysdea makes it simple to start modeling these systems, giving easy predictive power, while remaining easy to understand and show to others." Below this is another paragraph: "It's free to try, with nothing to install, and no need to register to try the tutorial." and "Once you've registered you'll have a 30 day free trial." A blue button labeled "Try Now For Free" is positioned at the bottom of the main content area.



Example: Launch-plan for a new *consumer-technology product*

Alan Analyst is depressed - he has to make a sales and profit plan for a new *consumer-technology product*. Is there anything *better than Excel*? Yes ... !!

perhaps *10 million potential customers*

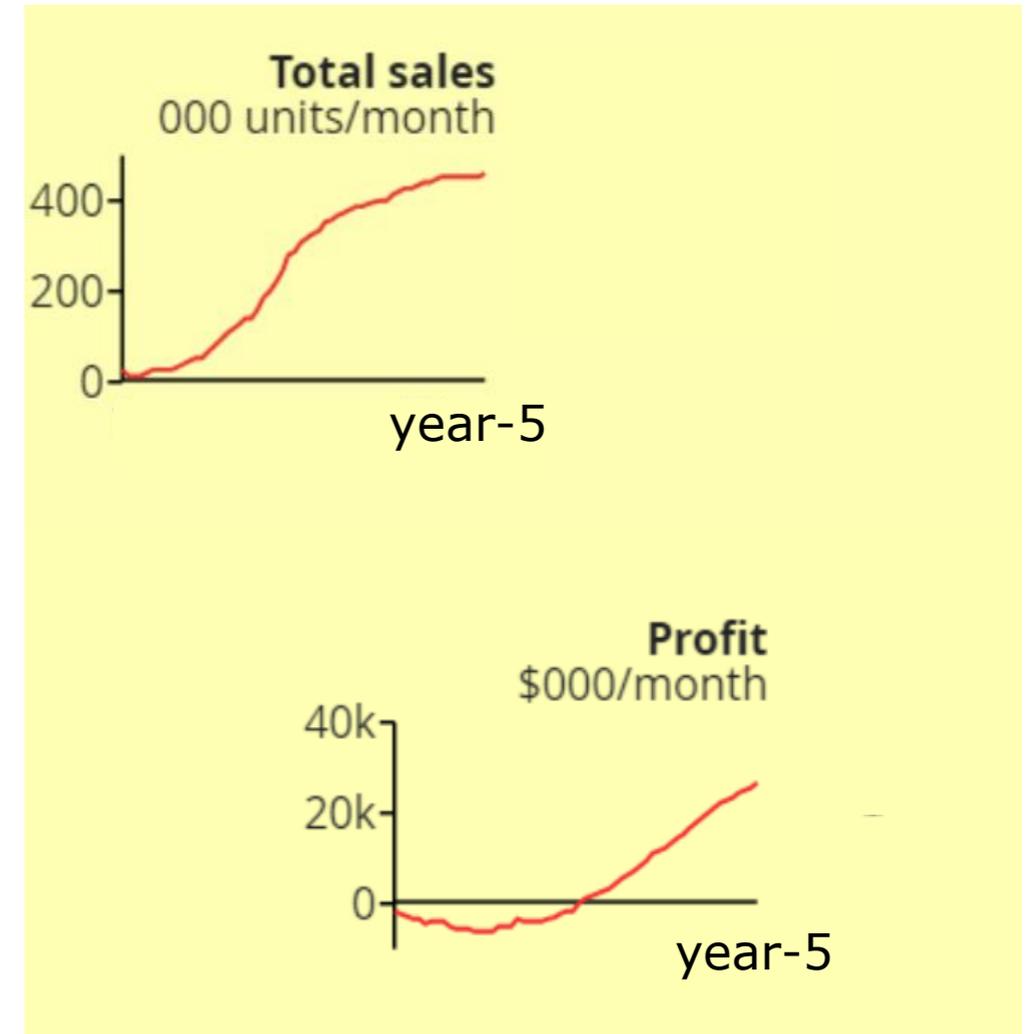
other products succeeded over *3-5 years*

... spending up to *\$5m/month marketing* to get demand going

before *word-of-mouth* helped growth take off

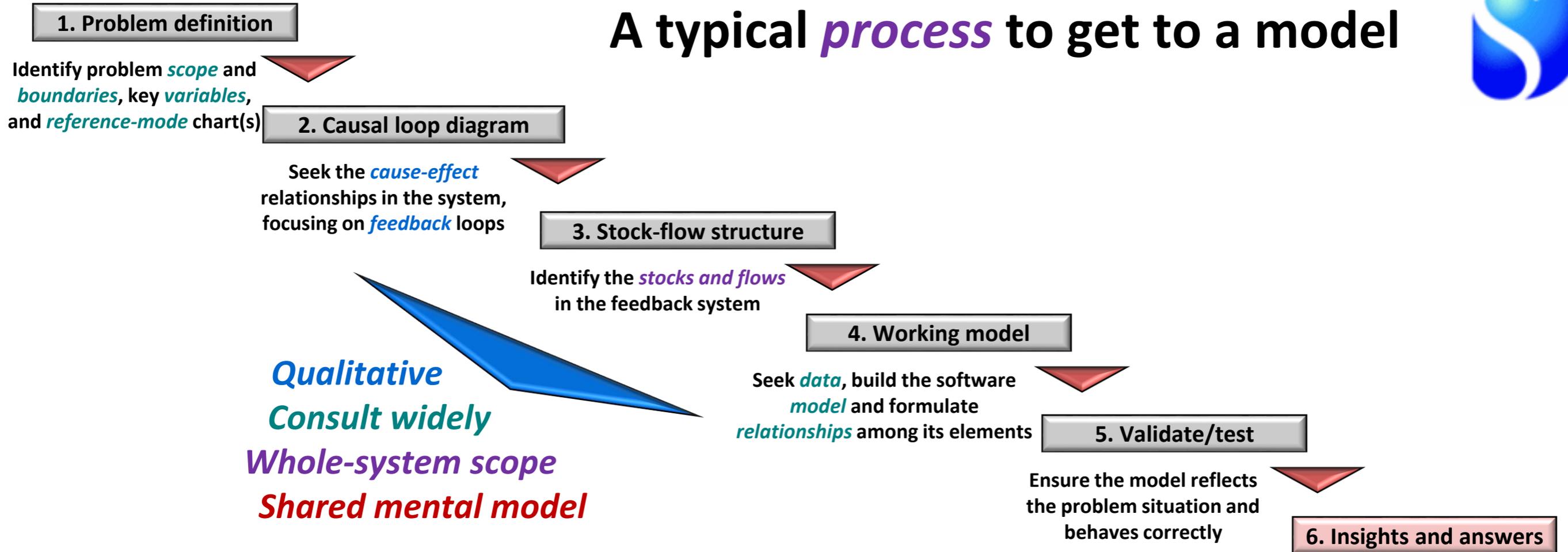
~5% of owners/month buy *new versions* (after year-1)

the product *costs \$180*, but could *fall to <\$80* as production grows





A typical *process* to get to a model



Variations ...

- Influence diagrams
- Qualitative stock-flow
- Modular approach
- other ... ?

Problems ...

- Takes too long
- Costs too much (time+money)
- Uncertain, late benefits
- Only experts can do it

An *agile* alternative? ... follow the generic *principles* of our method (*the “theory”*)



1. Explain and improve *performance over time*

2. Quantities of *Stocks drive performance* at any point in time

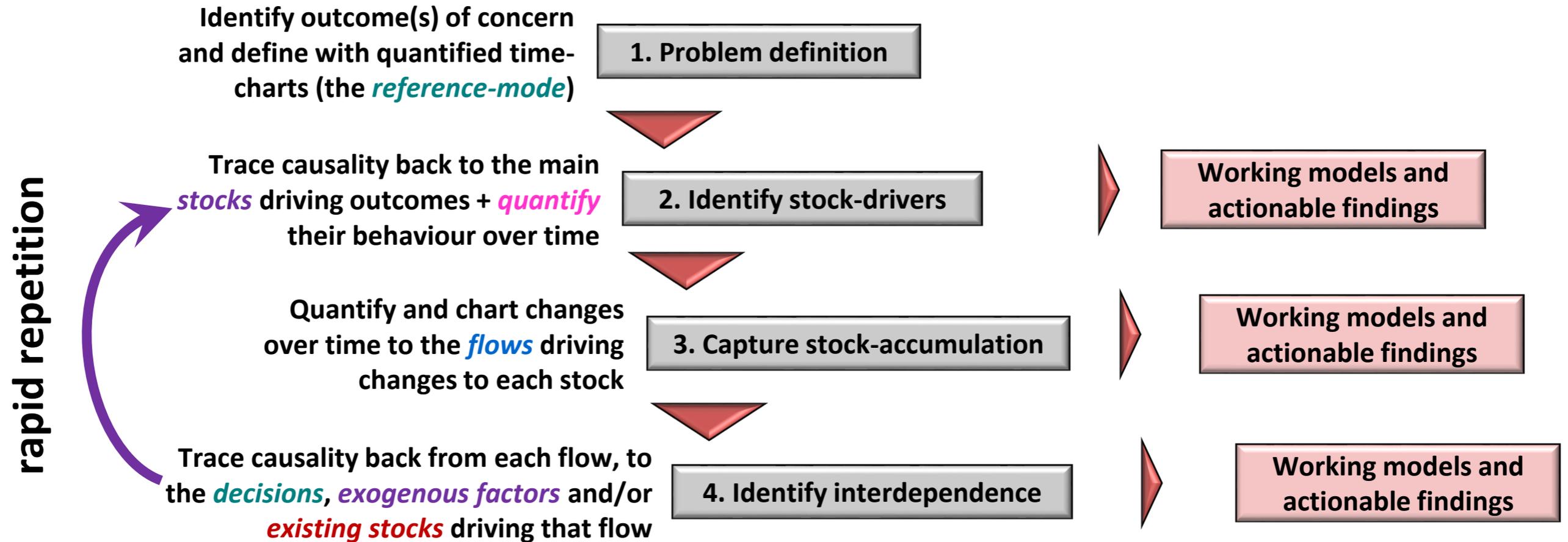
... *Decisions and External factors also drive current performance*

3. Resource-stocks *accumulate*, driven by *flow-rates*

4. *Decisions, external factors* and *existing stocks* drive the flow-rates (*causing feedback*)

[This is *a process* – it’s not about a particular software !!]

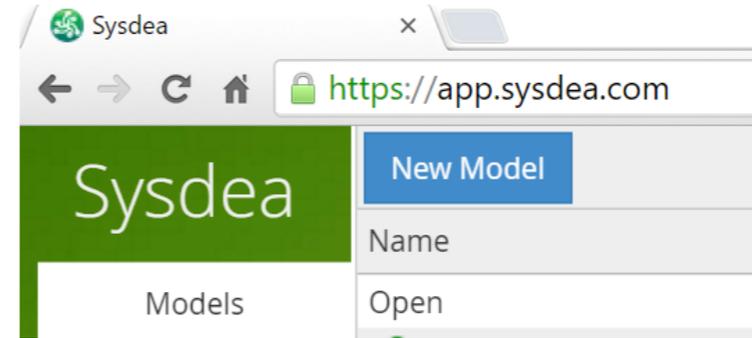
An agile *process* to build system dynamics models



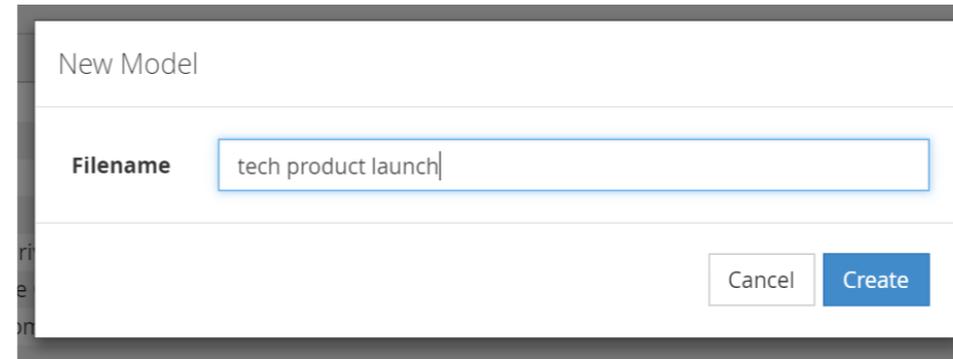
(each flow-rate becomes a new “dependent variable” on which the process is repeated)



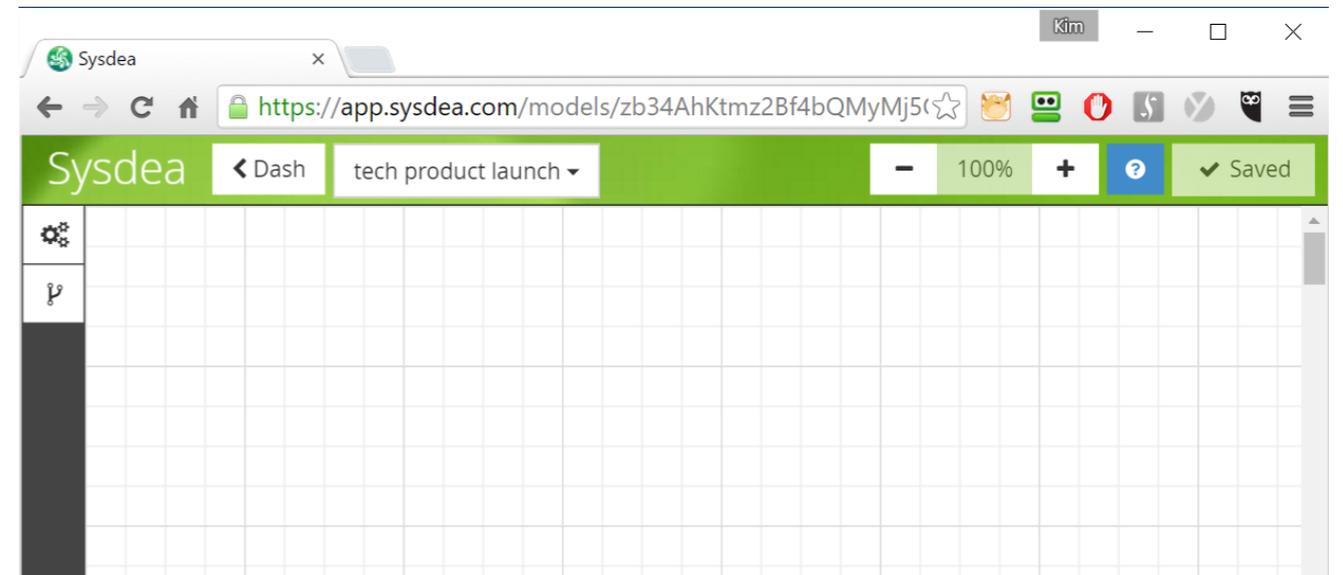
In Sysdea's Dash, click **New Model**



Enter *your choice of name*



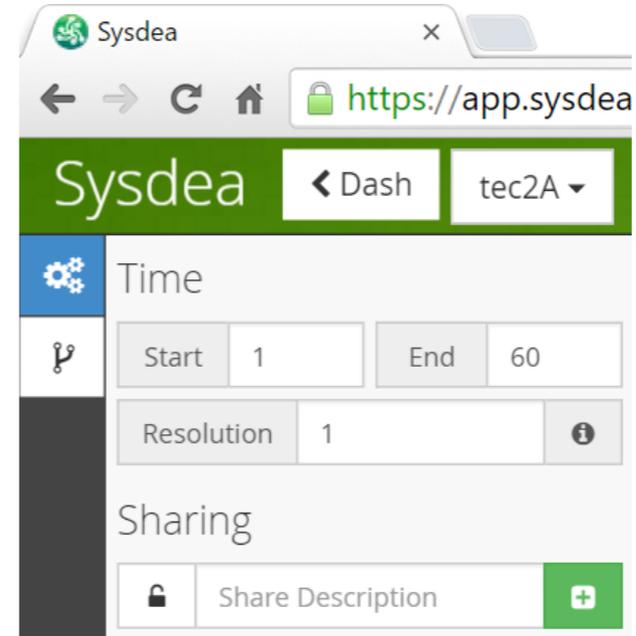
Click 'Create' - the empty model opens in **Sysdea**



Step 0: set up the model time-scale



In Settings  set start-time to 1 and end-time to 60 ... 5 years, in months

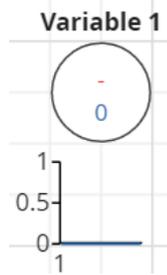


Step 1: Chart the performance-over-time



click the *Table Tab* to change, enter, or paste the numbers!

Set out the objectives for total sales ...



click at lower-right of the workspace to close Settings

hit '**V**' to add a *Variable*

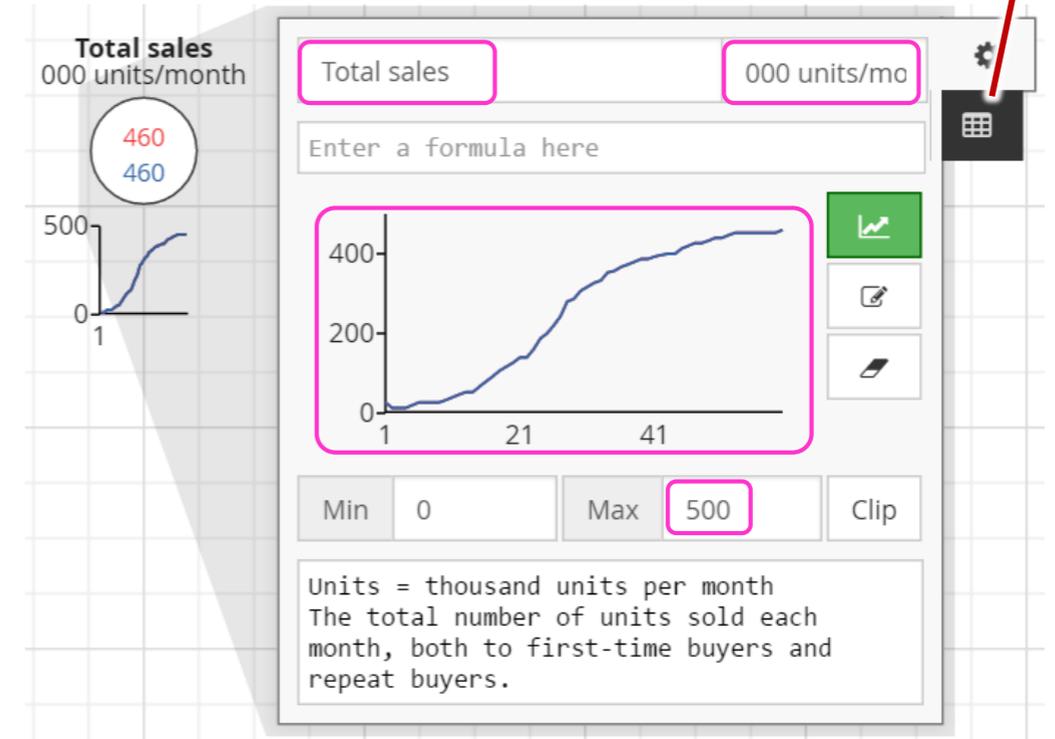
click the Variable's *circle-icon* to open the Inspector

replace the *Name* 'Variable 1' with **Total sales**

... tab to the '*Stub*' and enter **000 units per month**
[extra text, not part of its Name]

change the *Chart Max* value to **500**

'*sketch*' on the chart with the mouse an 'S' shape growth of sales from zero up to about 500 [your target for how sales will grow]





Strategy questions : 2 purposes at 2 levels ...

Purpose

... for an *overall* plan

... for a *specific* issue

Level

... for the *whole*
organisation

The *strategic plan* for a whole
company.

The strategy for a *new*
enterprise.

Defeating a *competitor*.

Merging with another
company.

Responding to a *recession*.

... for a *team*,
function or
department

The *marketing* plan.

A *human resources* strategy.

The *IT strategy*.

Fixing poor *service quality*.

Changing a team's *skills*.

Cutting new product *lead-*
times.

So "strategy" is *every*
manager's challenge

Step 1: Chart performance-over-time *for your plan or issue ...*



1. Create a new model

2. Set the time-scale

... enough history to tell you how the system works

... enough future to capture the full outcomes

... short-enough time-units to capture important patterns and response-times

3. Add a Variable for the key indicator of performance (or 2 indicators)

... name it accurately

... add accurate units (in the Stub if you wish)

... set the Chart-scale

... Sketch how historic values have changed

... and how you want (or fear) future values will change

Share your model ...



In Settings, Click green 'Create share'

Right-click the link that appears and 'copy link address'

email to others

Step 2: Stocks drive performance – past, present, future



Add sales from 1st-time buyers and repeat-sales ...

above **Total sales**, add another *Variable* **1st-time sales** with *Stub* 000s/month

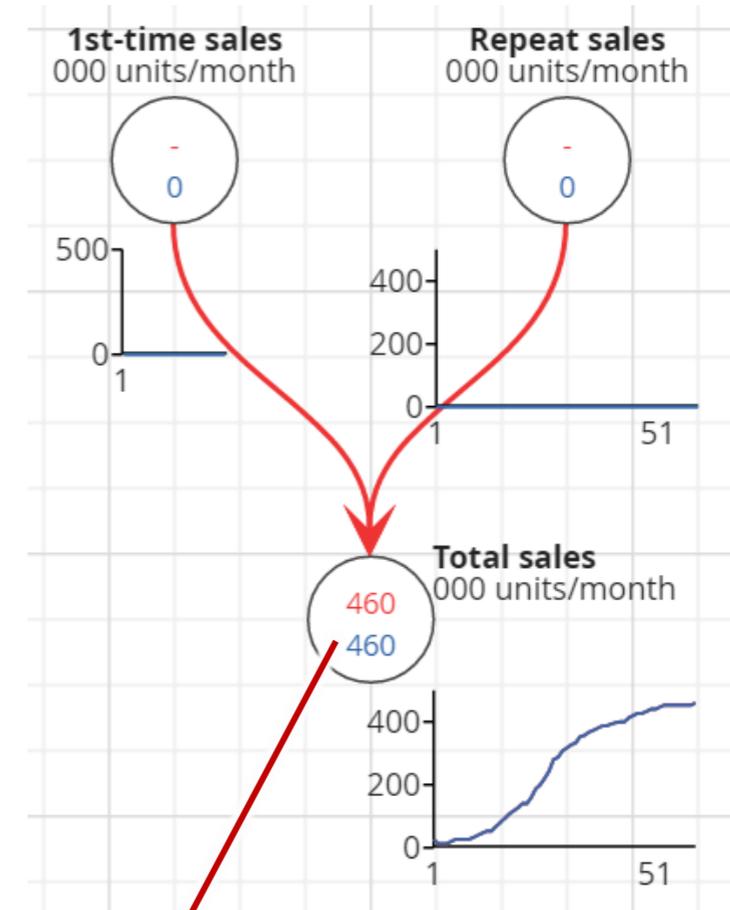
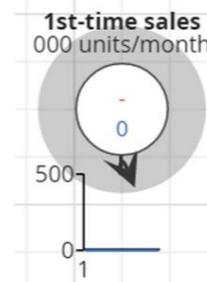
... and *another Variable* **Repeat sales**

move *the pointer* close to **1st-time sales** until a grey 'cloud' appears

.. click-hold-drag the pointer to pull *a link* arrow until it connects to **Total sales**

link **Repeat sales** to **Total sales**

Drag Variable names/charts or link-arrows to rearrange .. double-click to delete link-arrows .. Ctrl-Z to undo any number of steps .. Ctrl-Y to re-do



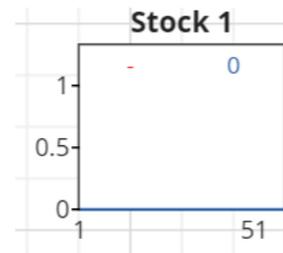
the **dependent variable** we want to explain

Step 2: Stocks drive performance – past, present, future



Add 'owners' who will drive repeat sales ...

above Repeat sales, hit '**S**' to add a *Stock* (something that 'fills up')

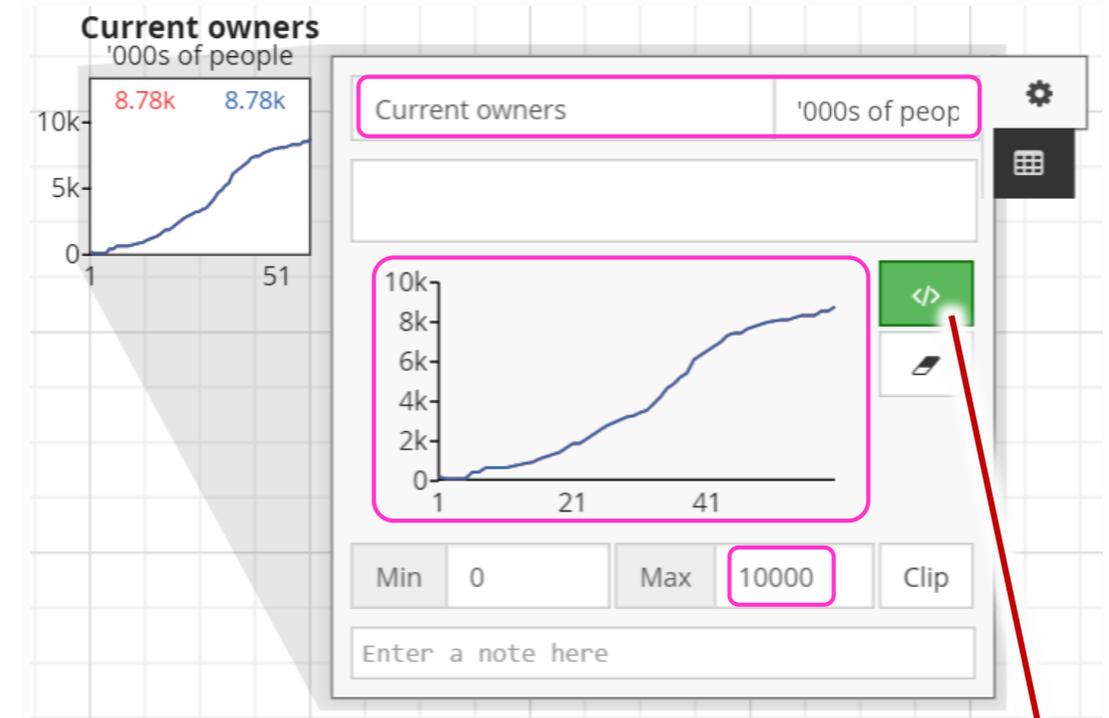


click the Stock's *icon* to open the Inspector

replace the *Name* 'Stock 1' with **Current owners** and '*Stub*' of '**'000s of people**

change the *Chart Max* value to **10000**

'*sketch*' on the chart with the mouse an 'S' shape growth of owners from zero up to about 8-9,000 [your target for how owners will grow]



click **</>** to make the **Stock act like a Variable**

Step 2: Stocks drive performance – past, present, future



Make 'owners' drive repeat sales ...

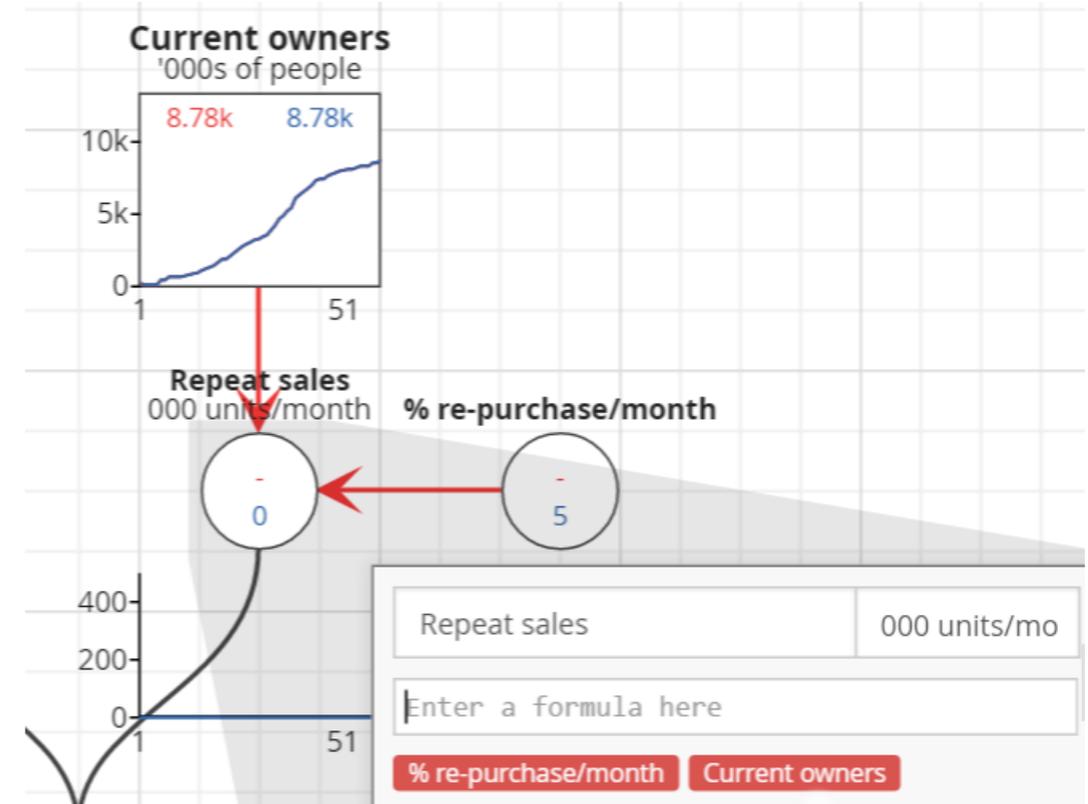
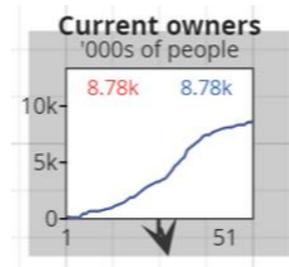
move *the pointer* close to **Current owners** until a grey 'cloud' appears

.. click-hold-drag to pull *a link* arrow until it connects to **Repeat sales**

add a Variable **% re-purchase/month** with a value of .. **5**

... and drag a link to **Repeat sales**

click **Repeat sales** to open its Inspector – the linked items are shown **in red** below the *Formula box*



click any **linked object** to add it to the Formula

Step 2: Stocks drive performance – past, present, future



Make 'owners' drive repeat sales ...

in the *Inspector* for Repeat sales

.. click **Current owners** to add this *linked Variable* to the *Formula*

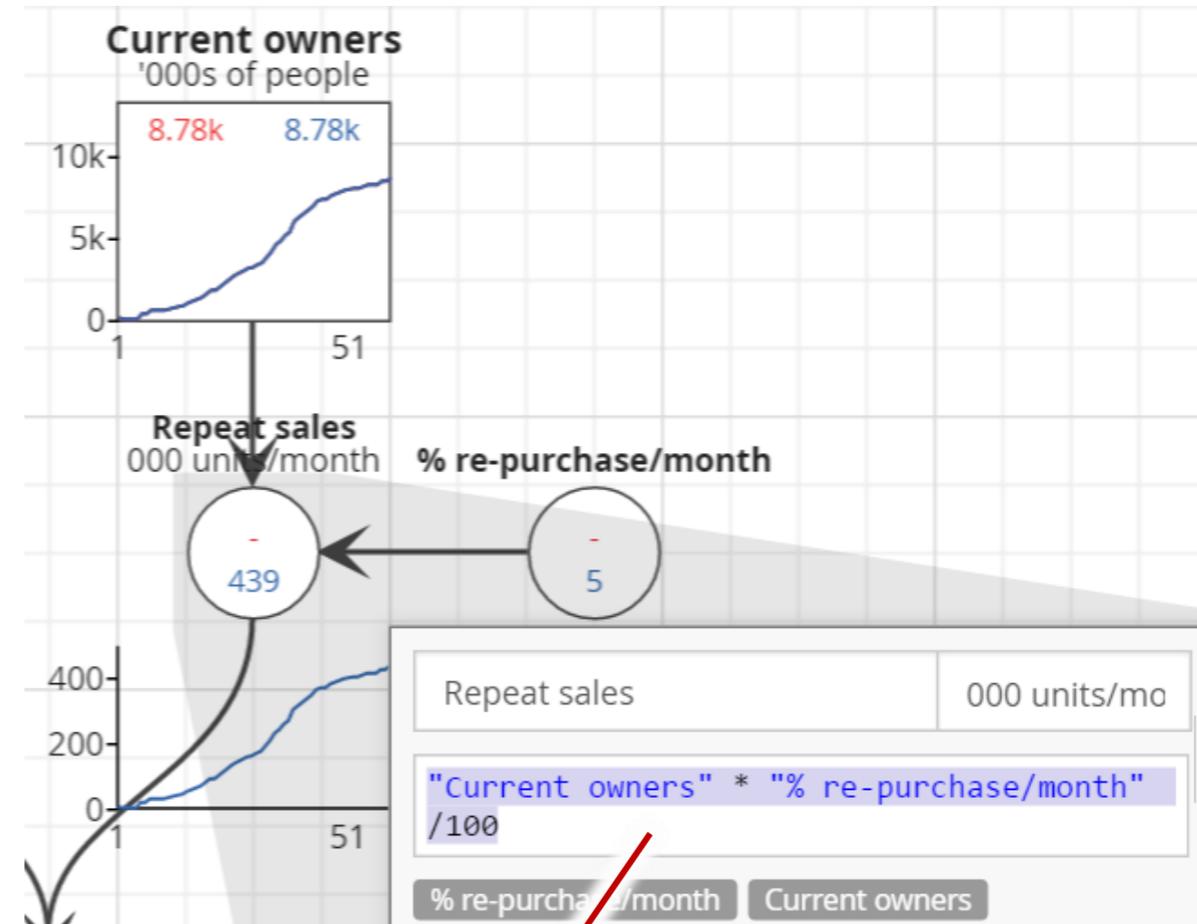
hit .. * .. for multiply

.. click **% re-purchase/month**

.. and type .. / 100

the Formula should read ..

"Current owners" * "% re-purchase/month" / 100



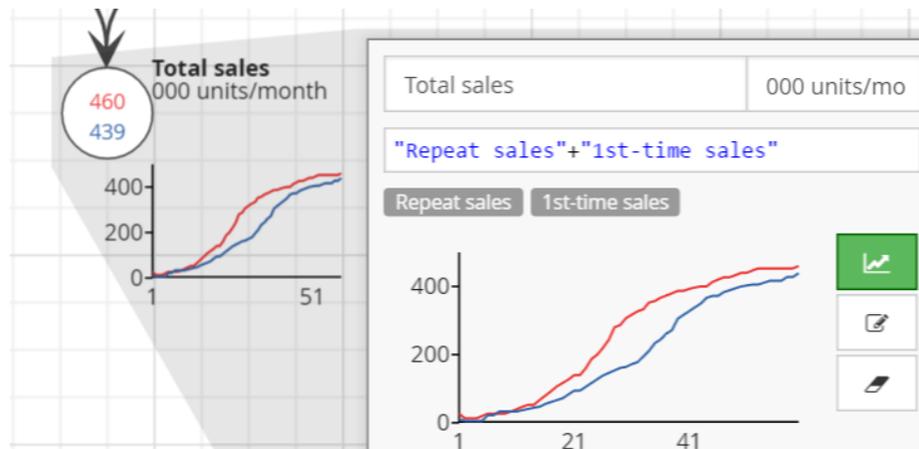
Step 2: Stocks drive performance – past, present, future



Make 'owners' drive repeat sales ...

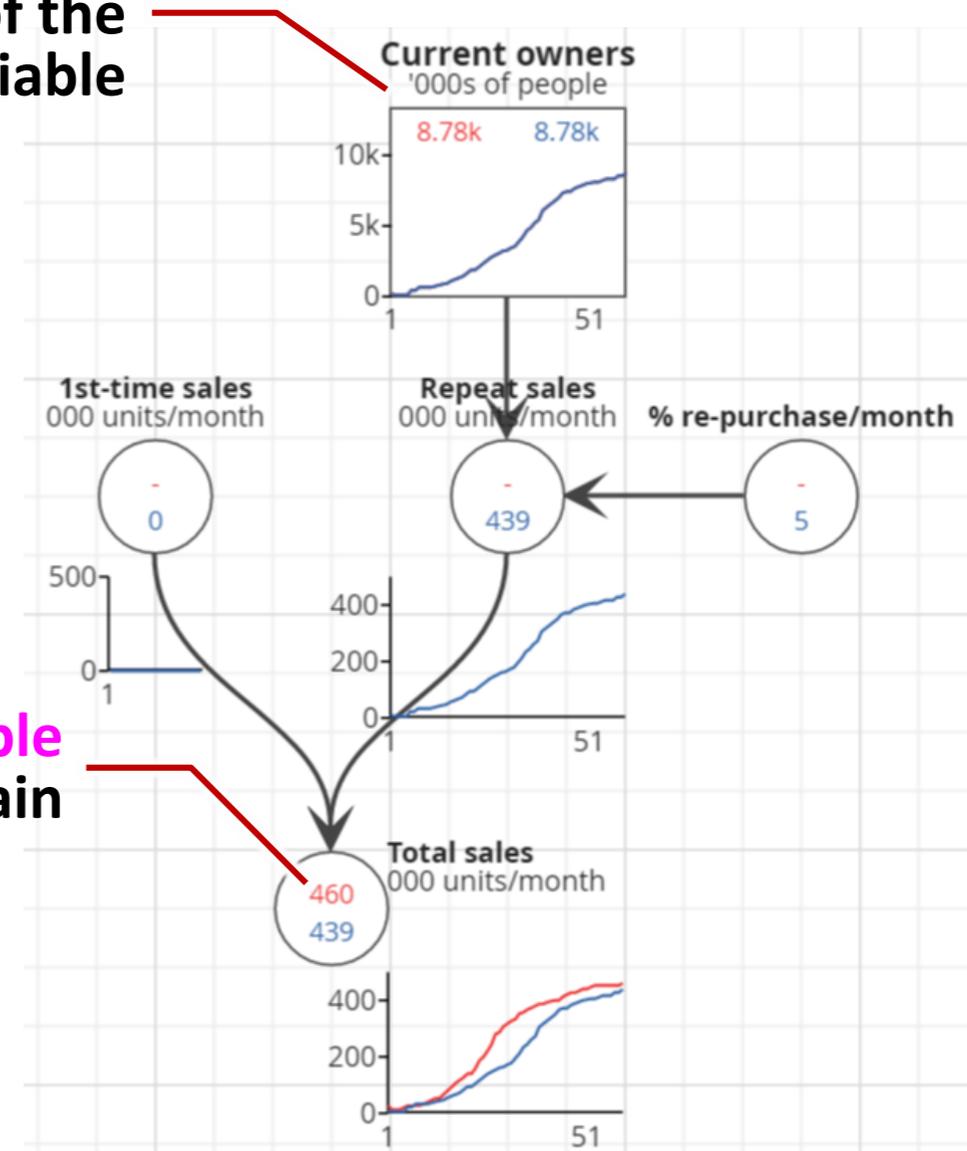
in **Total sales** .. click the **linked items** to make the Formula ...

"Repeat sales"+"1st-time sales"
(no 1st-time sales just yet)



the **independent variable**
'causing' the value of the
dependent variable

the **dependent variable**
we want to explain



You can retake this 'class' at any time ...



sdl.re/AgileCourse ... videos

sdl.re/tec2slides ... includes links to the models

Step 2: Model “Stocks drive performance” for your plan or issue ...



1. Is your Step-1 performance indicator actually a Stock ???!

*... if so, then **replace** the Variable from Step 1 with a Stock that has the same name and values*

*... make the Stock **‘act as Variable’***

2. Add the Stock or Stocks driving your performance indicator

... Sketch its values-over-time

*... make the Stock **‘act as Variable’***

3. Add other items to calculate how each Stock drives the performance

... add other Variables needed between the Stock and the performance item

... give the Stock precisely accurate names and units

... add links and Formulae to make the values of the Stock give an accurate match for the performance item

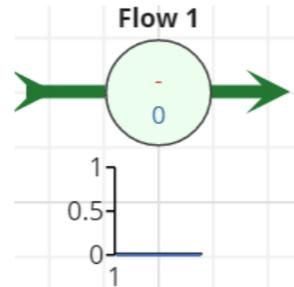
Step 3: Stocks accumulate



Add a 'Flow' of 1st-time buyers ...

to the left of **Current owners**

.. hit '**F**' to add a *Flow* object

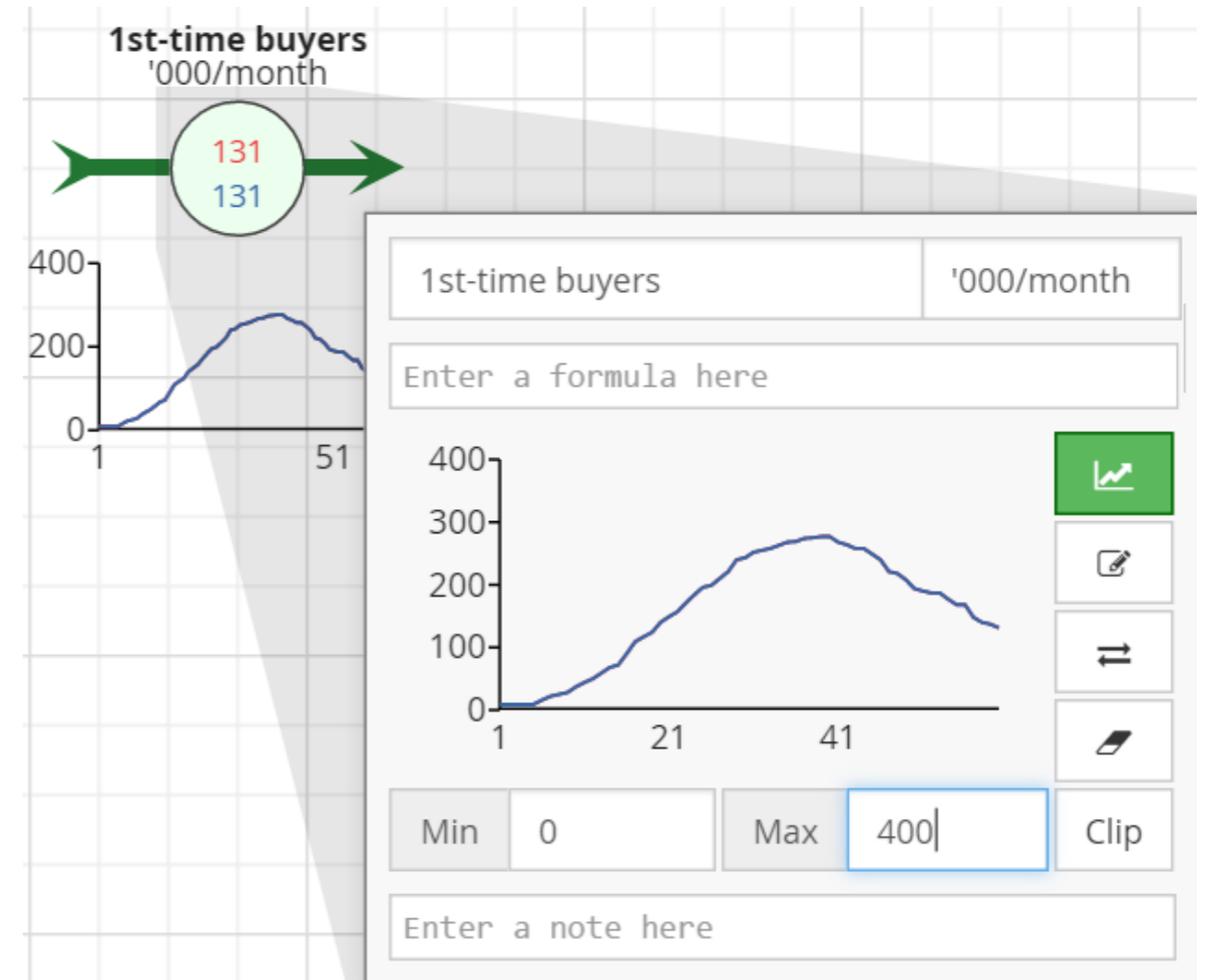


click the Flow's *icon* to open the Inspector

replace the *Name* with **1st-time buyers** and
'*Stub*' of **'000s/month**

change the *Chart Max* value to **400**

'*sketch*' on the chart growth-and-decline of
1st-time buyers [*growth slows as you run
out of potential customers*]



Step 3: Stocks accumulate



Make '1st-time buyers' drive growth of owners ...

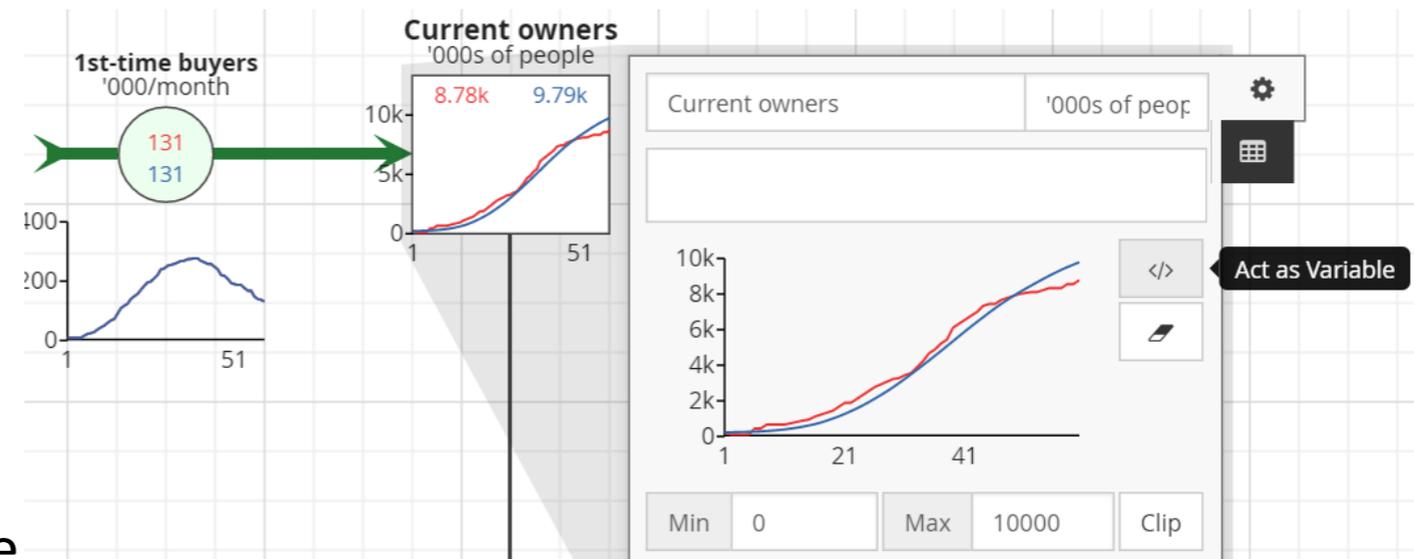
click-hold the **arrow-head** on **1st-time buyers**

.. and drag it to connect to the **Stock** of **Current owners**

in the Inspector for **Current owners**

click **</>** to make the Stock be driven by the Flow of 1st-time buyers

change the '**sketch**' in **1st-time buyers** until the **Simulated** numbers of **Current owners** match the **Sketched** numbers



Step 3: Stocks accumulate



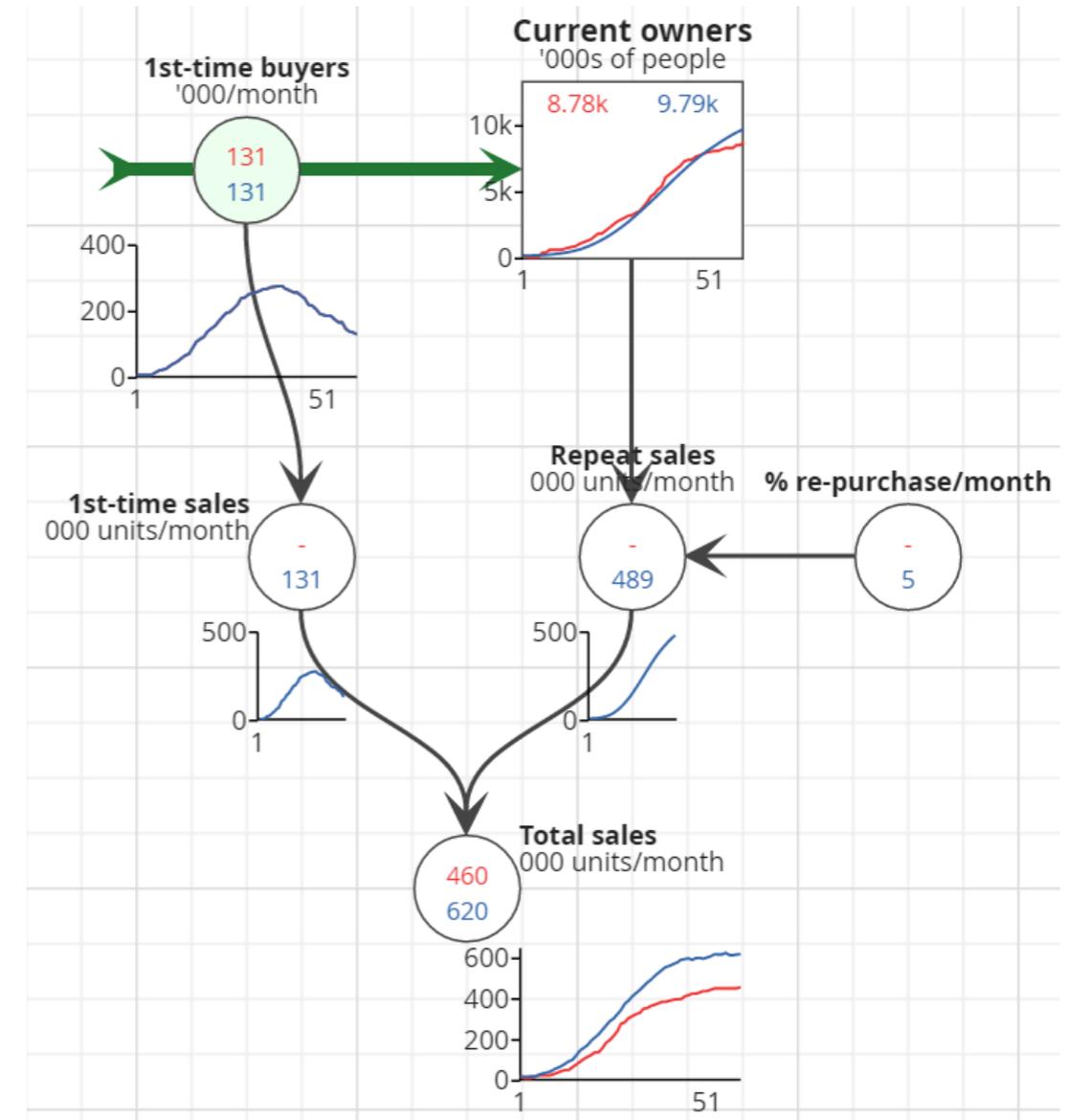
Make '1st-time buyers' drive growth of owners ...

link 1st-time buyers to 1st-time sales

.. and make the Formula for 1st-time sales simply ...

"1st-time buyers"

This model is at sdl.re/tec2A
... you can change this model – and save it if
you have an account at www.Sysdea.com



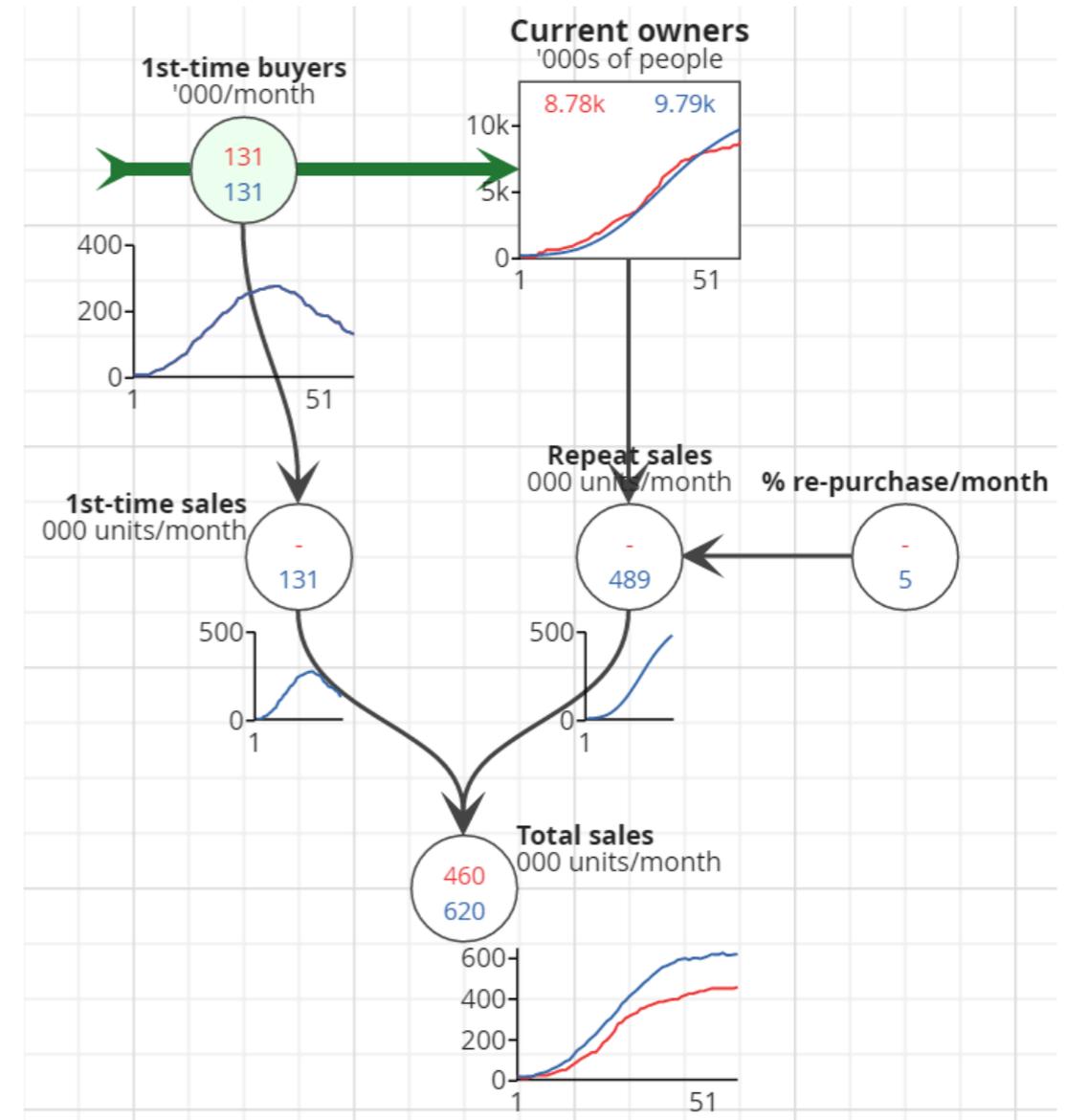
[set things to happen at, or from, certain times]



Make Repeat sales start after the first year ...

Change the Formula for **Repeat sales** to ...

if "time" > 12 then "Our current owners" * "% owners re-purchase/month" / 100 else 0



Step 3: Model “Flows change Stock-levels” *for your plan or issue ...*



1. Is your Step-1 performance indicator actually a Flow ???!

... if so, then **replace** the Variable from Step 1 with a Flow that has the same name and values

... link this to the Stock it fills or drains and make the Stock **‘act as Variable’**

2. Add an in-flow to your Stock

... name it precisely and make sure its units are [Stock]-per-time-unit

... Sketch how its values change over time

... link the flow to the Stock and **switch off ‘act as Variable’**

... check that the Stock’s behaviour makes sense (it may not match the Stock’s Sketched time-path until the out-flow is added)

3. Add an out-flow from the Stock

... repeat the steps you did for the in-flow

... check and adjust the in-flow and/or out-flow to make the Stock’s **simulated values** match the **sketched** values

Step 4: Stocks (+Decisions +external factors) drive Flow-rates



'Use up' the population of potential buyers ...

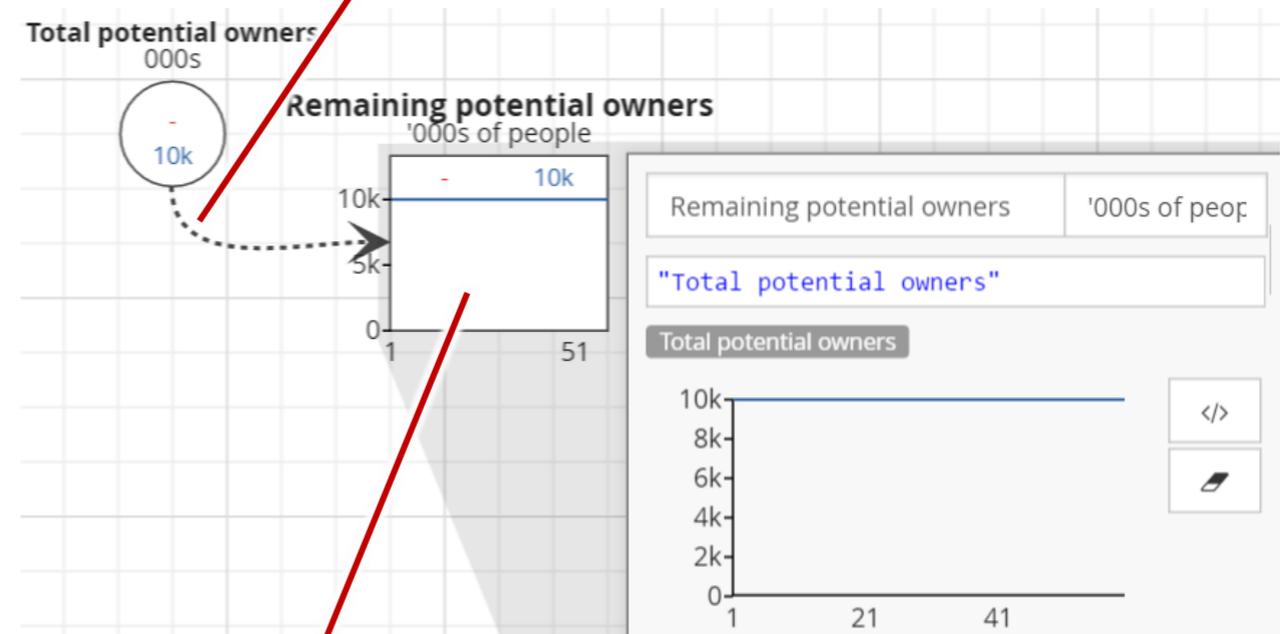
to the left of 1st-time buyers hit '**S**' to add a *Stock* of **Remaining potential owners**

.. to the left of that Stock add a *Variable* **Total potential owners ('000s)** with a value of **10000** .. *that is 10 million potential owners*

link **Total potential owners** to the *Stock* of **Remaining potential owners**

.. in **Remaining potential owners ('000s)** click the linked Variable name to make the Formula simply **"Total potential buyers"** .. *you start with 10 million!*

the dotted line shows that you are **only** setting the Stock's **initial** value



... all **later** values will depend on the Flow of buyers out of this Stock

Step 4: Stocks (+Decisions +external factors) drive Flow-rates



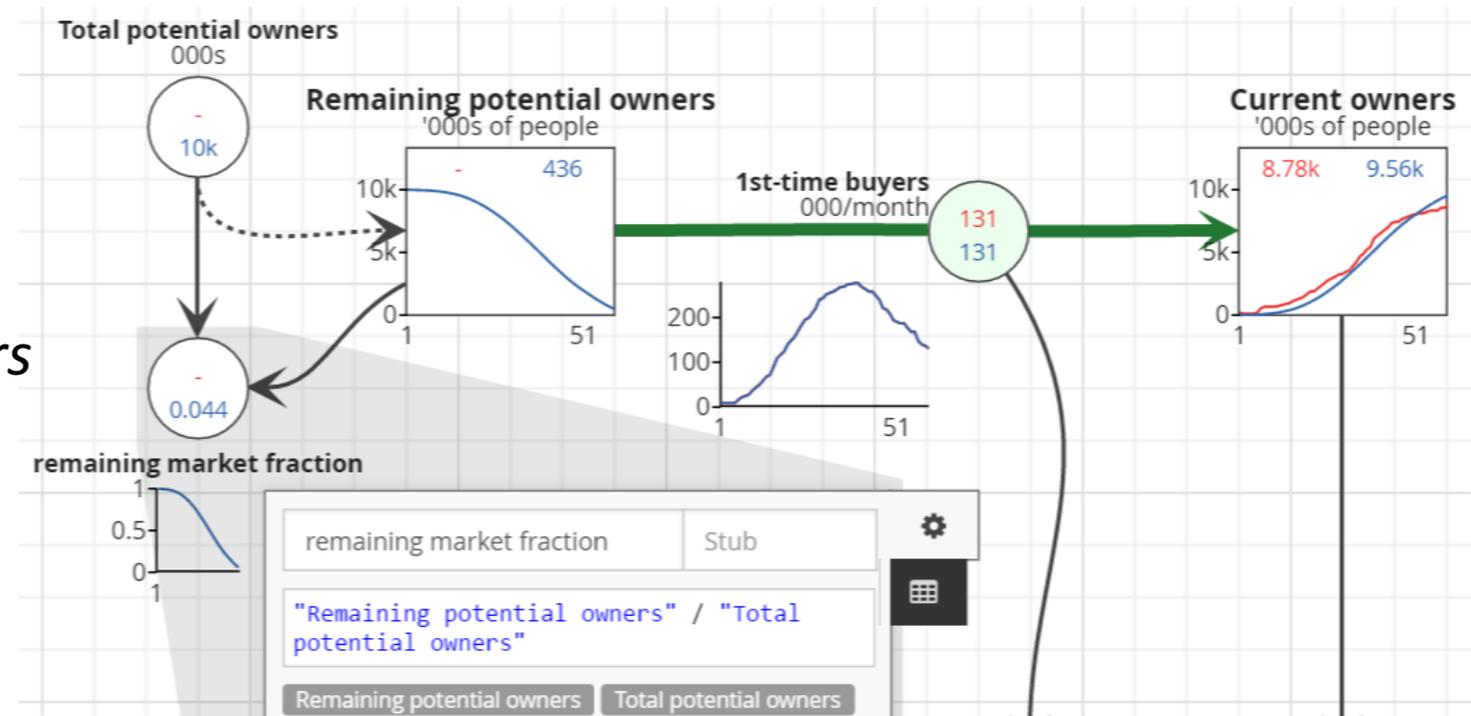
'Use up' the population of potential buyers ...

click-drag the 'tail' of the *Flow* of **1st-time buyers** until it connects to the *Stock* of **Remaining potential buyers**

.. that Stock's chart immediately shows the number of remaining potential buyers being 'used up' as they buy the product for the first time.

add and link a Variable **remaining market fraction** .. with Formula of ..

"Remaining potential owners" /
"Total potential owners"



Step 4: Stocks (+Decisions +external factors) drive Flow-rates



Add marketing spend to win 1st-time buyers ...

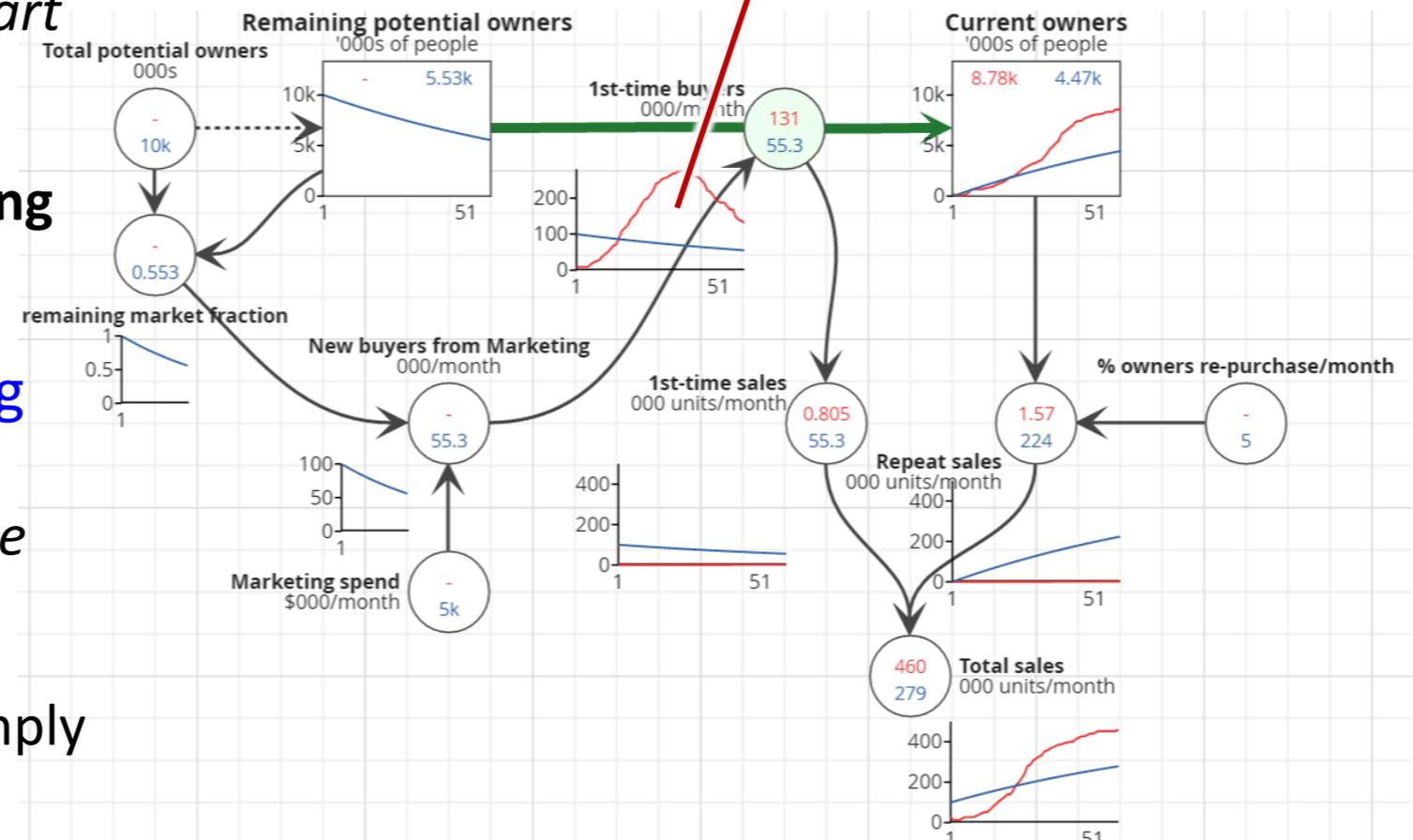
Add a *Variable* Marketing spend (\$000/month) with a value of 5000 .. start by spending \$5m/month

add a *Variable* new buyers from marketing with Formula ..

"Marketing spend"/50 * "remaining market fraction" .. it costs \$50 of marketing to win each 1st-time buyer, but the win-rate falls as the opportunity is used up

make the *Formula* for 1st-time buyers simply "New buyers from Marketing"

the win-rate pattern is **very different** from your sketch!



Step 4: Stocks (+Decisions +external factors) drive Flow-rates



create the links you need !

Add word-of-mouth to win more 1st-time buyers

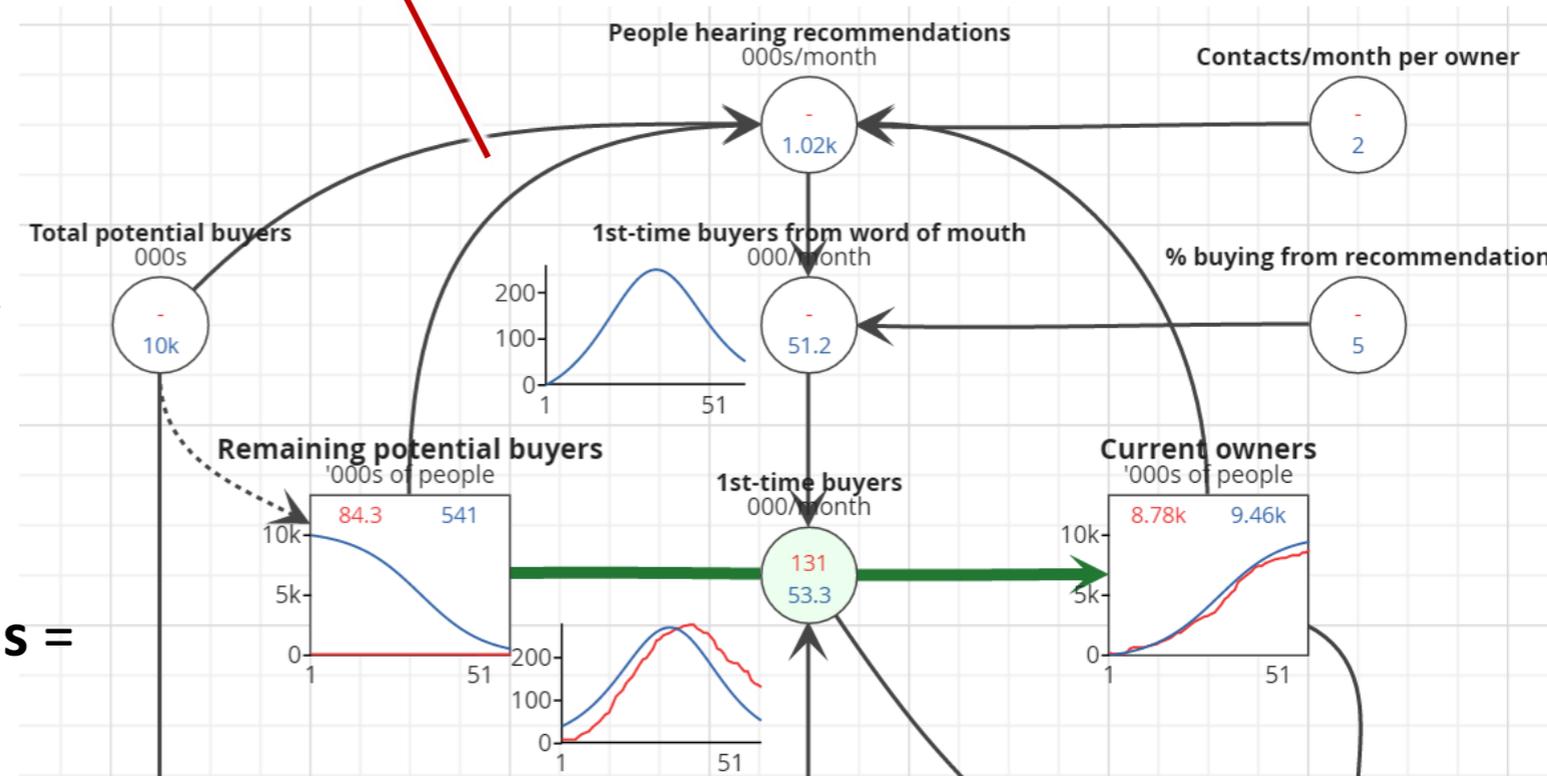
Add a Variable contacts/month/owner = 2

.. and people hearing recommendations =
"Contacts/month per owner" * "Current owners" * "Remaining potential buyers" /
"Total potential buyers"

Add % buying from recommendations = 5

.. and 1st-time buyers from recommendations =
"People hearing recommendations" * "%
buying from recommendation" / 100

change the Formula for 1st-time buyers to
("1st-time buyers from word of mouth" +
"New buyers from Marketing")



This model is at sdl.re/tec2B

Complete the working-out of revenue and profit



Add **our price \$ = 180**

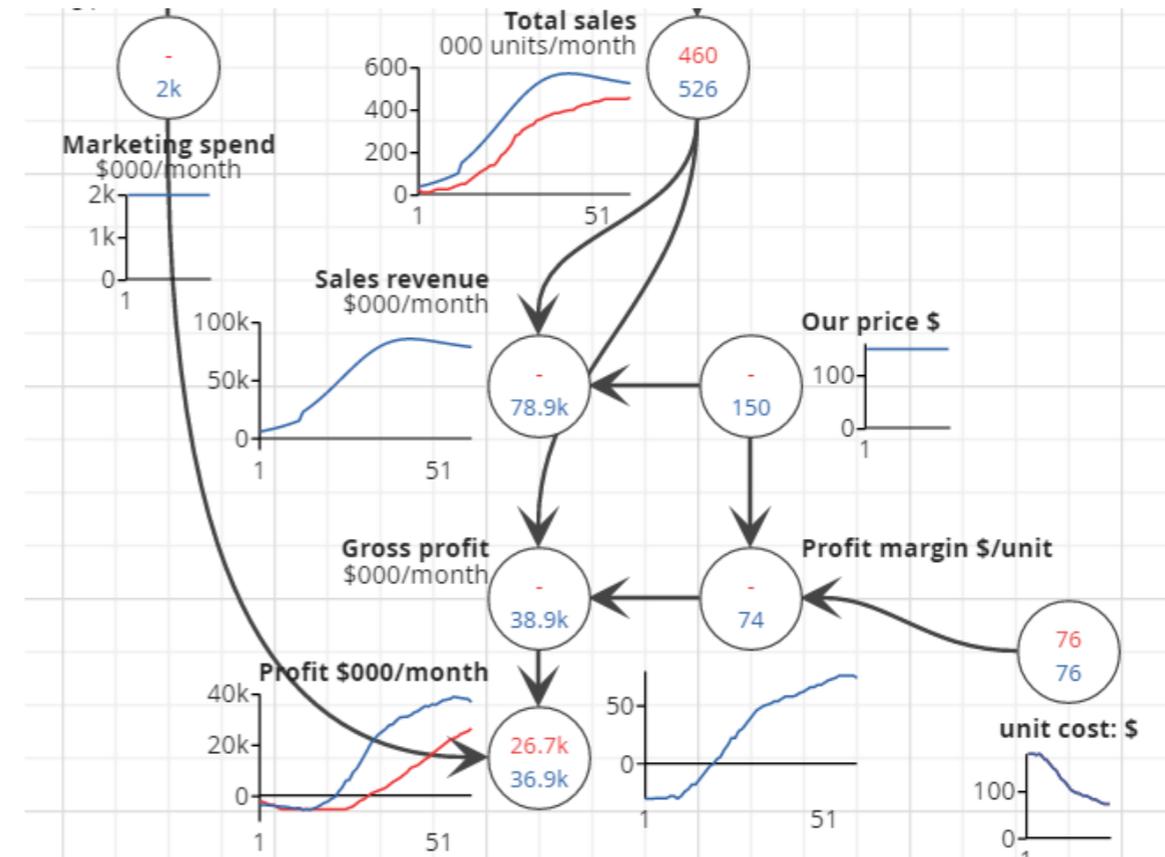
.. and add sales **revenue** = "Total sales" *
"Our price \$"

Add **unit cost \$** and sketch values falling from **180**
to about **80**

.. and add sales **profit margin** = "Our price \$" -
"unit cost: \$"

Add **gross profit** = "Total sales" * "Profit
margin \$/unit"

.. and **profit (\$000/month)** = "Gross profit" -
"Marketing spend"

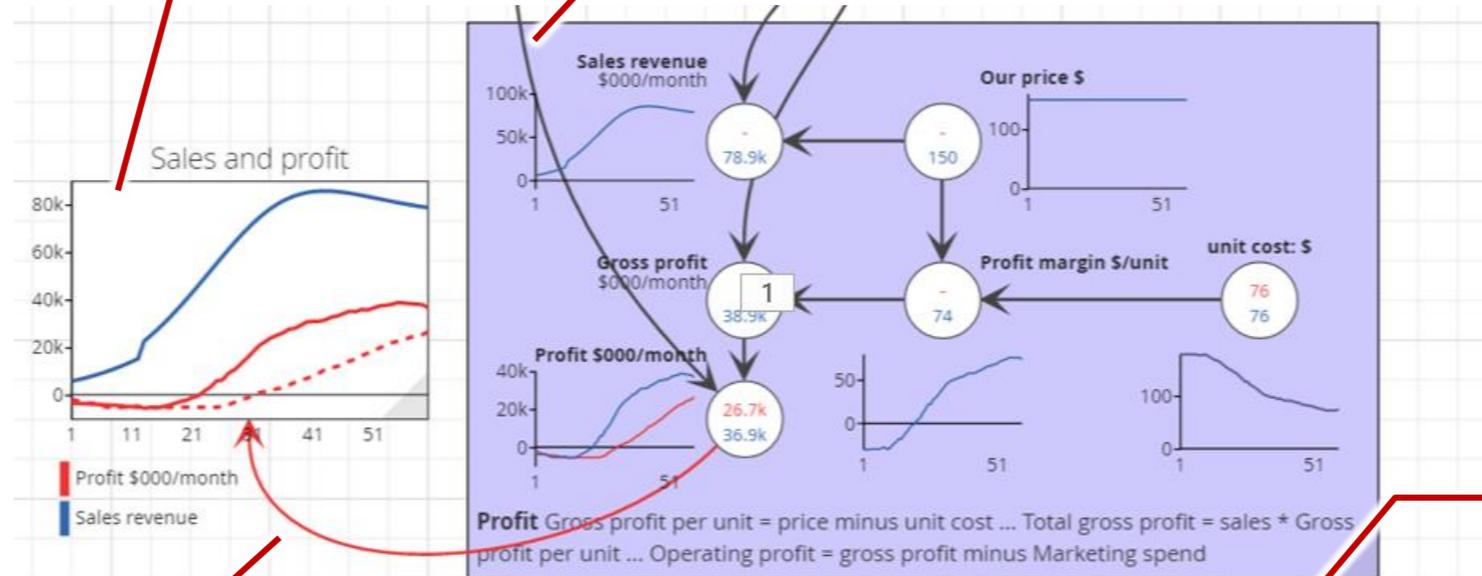


Add Notes, Charts and Tables ...



hit '**C**' to add a Chart
.. top-left is at
pointer-location

hit '**N**' to add a Note .. top-
left is at pointer-location



select the Table and
click columns to *copy*
to a spreadsheet

drag a link from objects
you want in the Chart

hit '**T**' to add a Table
... drag links to add
items to the Table

	1st-time sales		Repeat sales		Total sales		Sales revenue		G
	Sketched	Simulated	Sketched	Simulated	Sketched	Simulated	Sketched	Simulated	
1	0	40	0	0	27	40	-	6000	-
2	0.001	43.824	0	0	13	43.824	-	6573.6	-
3	0.002	47.977	0	0	13	47.977	-	7196.526	-
4	0.004	52.479	0	0	13	52.479	-	7871.875	-
5	0.006	57.351	0.001	0	20	57.351	-	8602.693	-
6	0.009	62.613	0.001	0	27	62.613	-	9391.912	-
7	0.012	68.282	0.002	0	27	68.282	-	10242.268	-
8	0.016	74.375	0.003	0	27	74.375	-	11156.209	-

This model is at sdl.re/tec2C

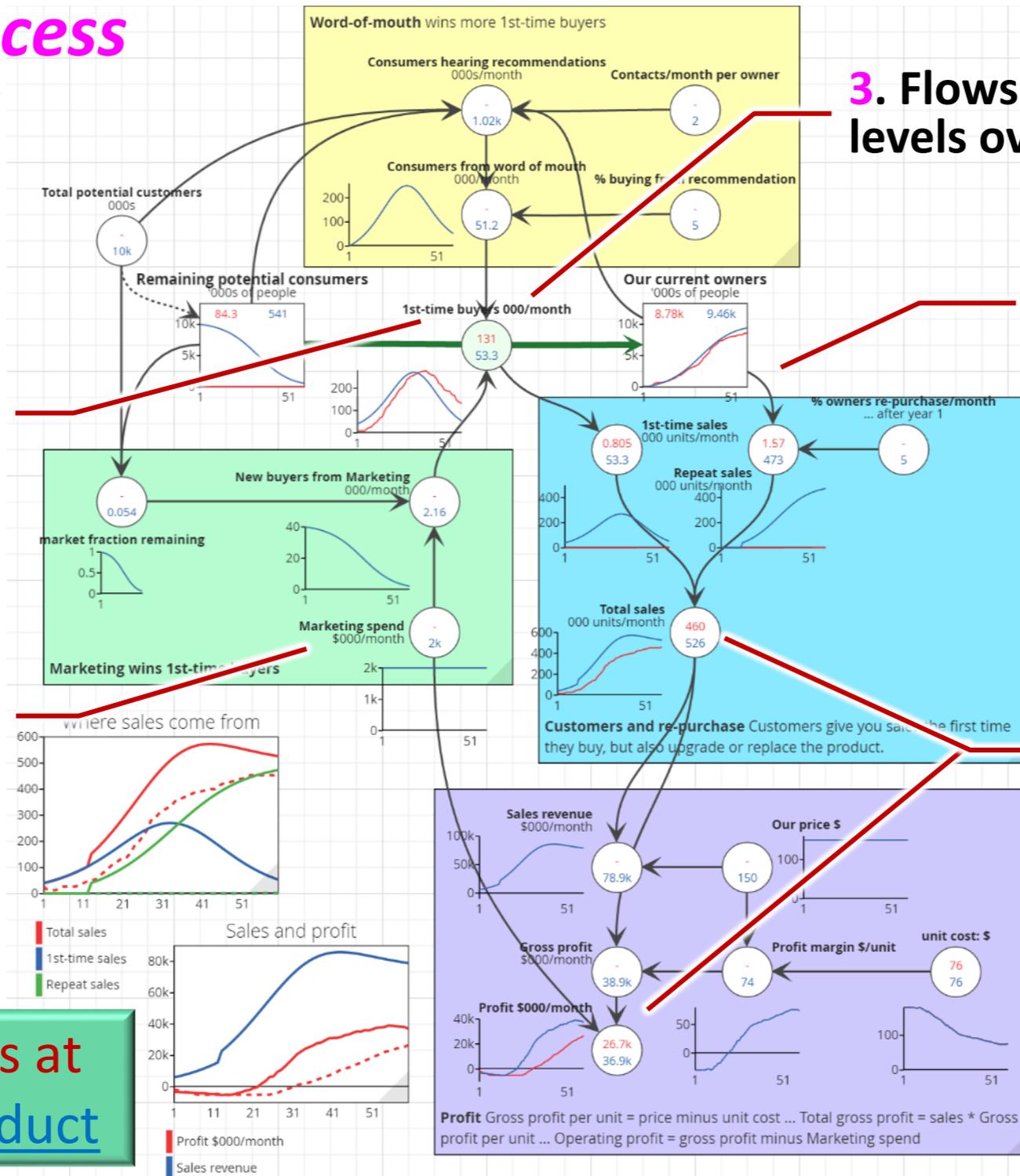
The *Agile process* we have now completed ...



4. Current Stocks drive flow-rates

2. (*Decisions* also drive current performance)

A *full model* is at sdl.re/tec2product



3. Flows change Stock-levels over time

2. Quantities of Stocks drive performance (at all times)

1. What is the performance-over-time we want to explain?

(*External factors* also drive performance and flow-rates .. *competition* in the full version of this model)

Step 4: Model how “Existing Stocks (+ decisions and external factors) drive each Flow” *for your plan or issue ...*



1. Add Decisions and/or External factors that directly drive any Flow-rate

... follow the same discipline as for step-2

... and enter values-over-time for each item that make the Flow values match what was needed to explain the Stock's values

2. Add Variables and causal-chains needed to explain other Flow-rates

... including any necessary potential Stocks

... follow the same discipline as for step-2

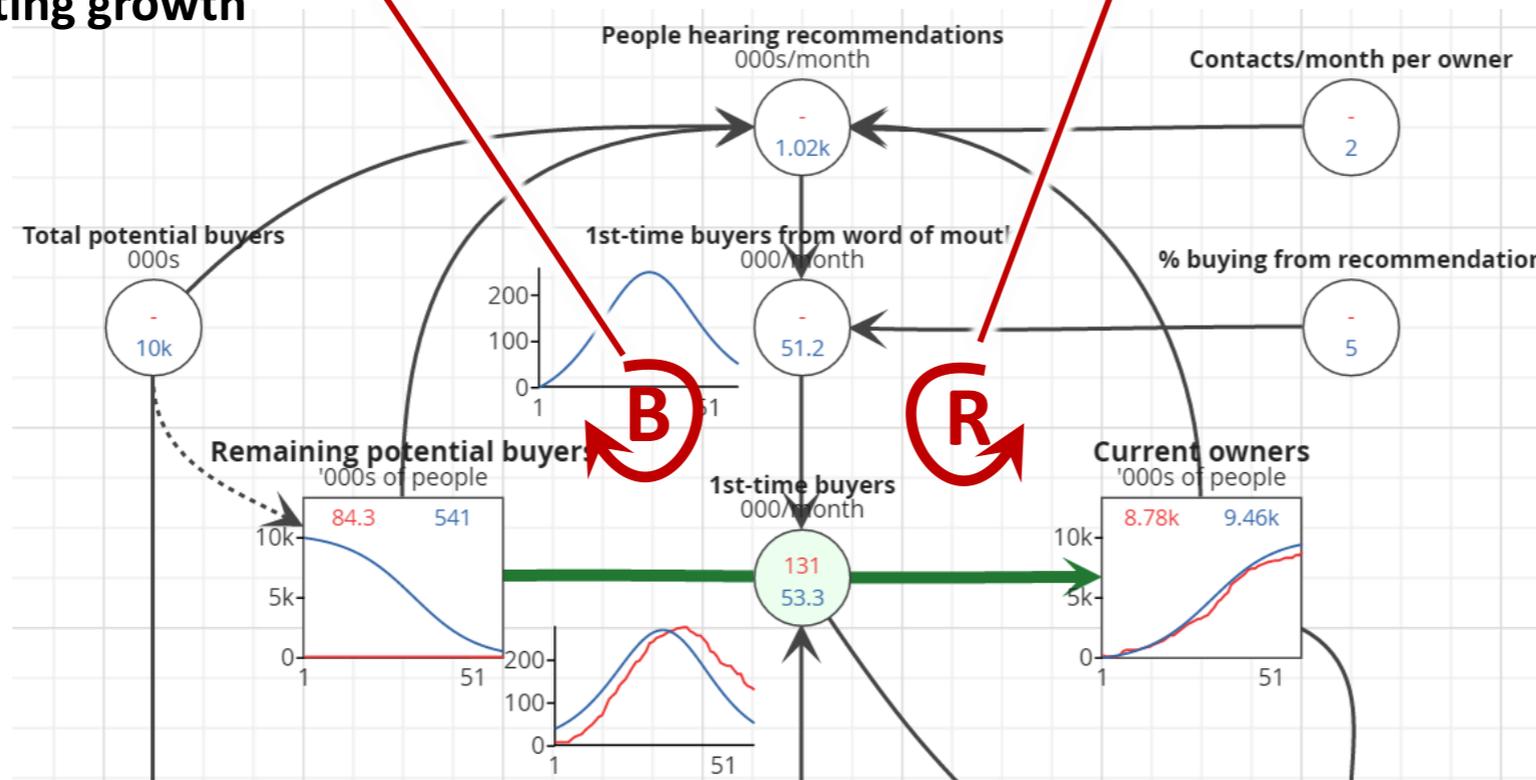
... and enter values-over-time for any new Stock that make the Flow values match what was needed to explain the Stock's values

When a Stock drives *its own* flows ... *feedback!!*



“B” = balancing feedback, limiting growth

“R” = reinforcing feedback, driving growth (or, in other cases, decline)



Dynamic challenges

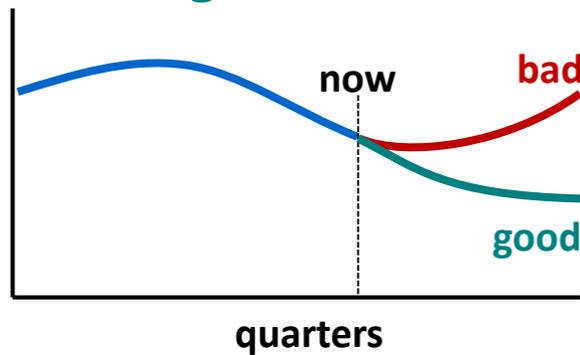


These cases have in common ... *a history*

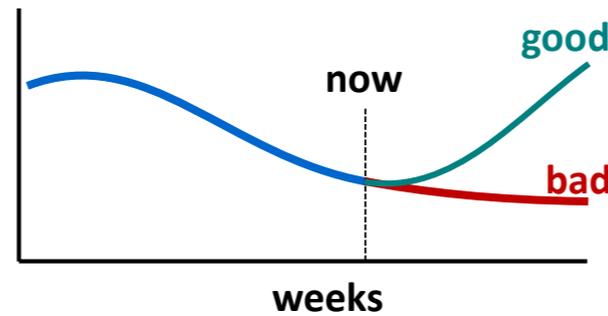
... the situation could get **worse**

... and will take *time to improve*

cutting staff turnover

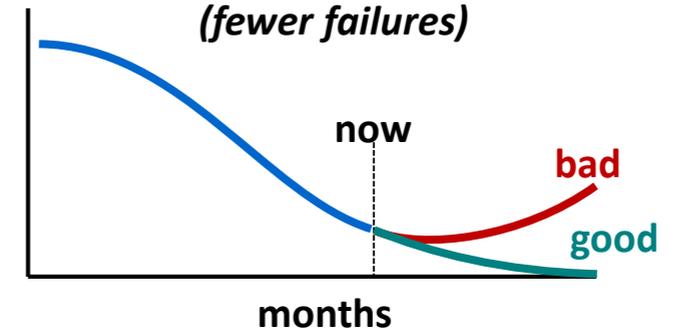


recovering sales

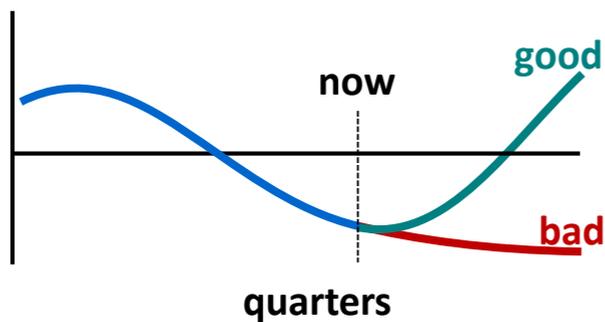


raising quality

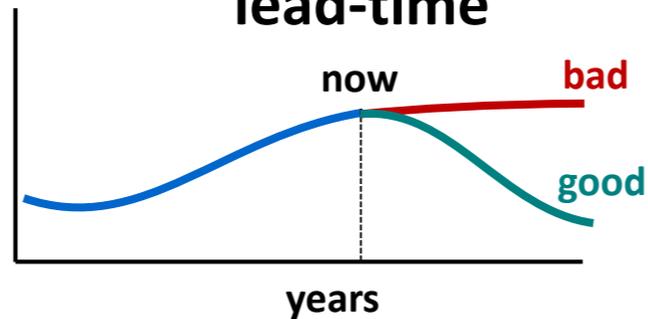
(fewer failures)



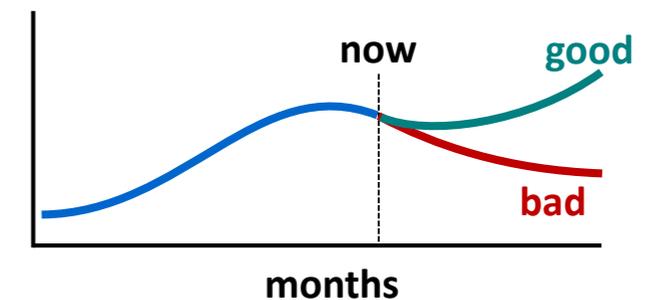
improving cash-flow



cutting new-product lead-time



growing company profits



Adding to the *core strategic architecture*



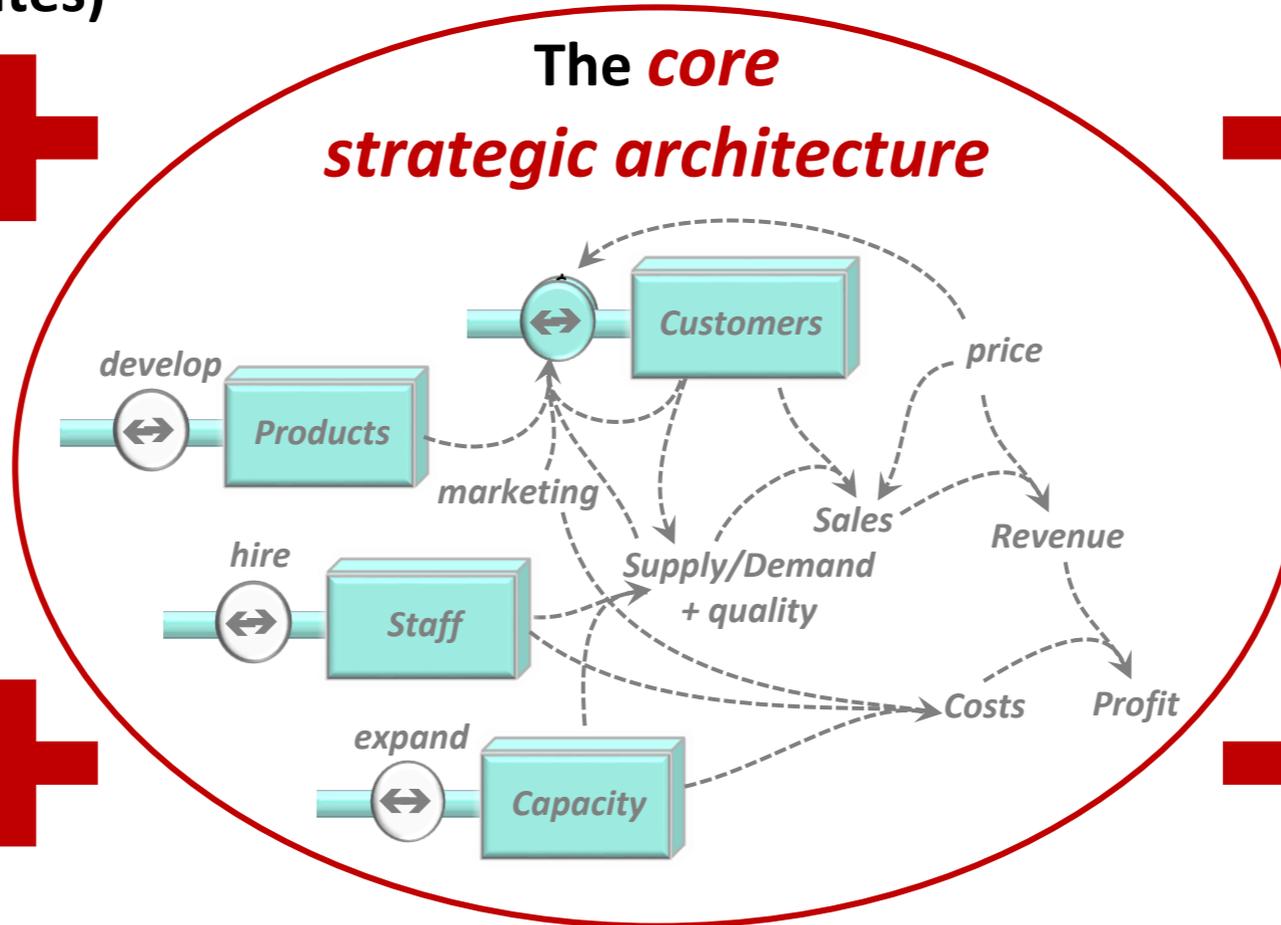
The *quality* (attributes)
of resources: class 5



How resources
develop through
stages: class 6



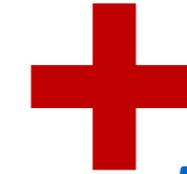
Competition for
resources: class 7



Policy to steer the
system: class 8



*Intangible
factors*: class 9

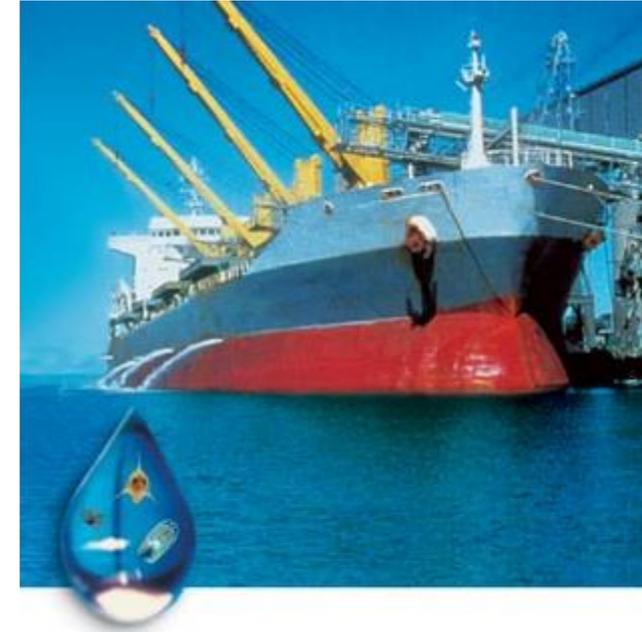


Capabilities:
class 10

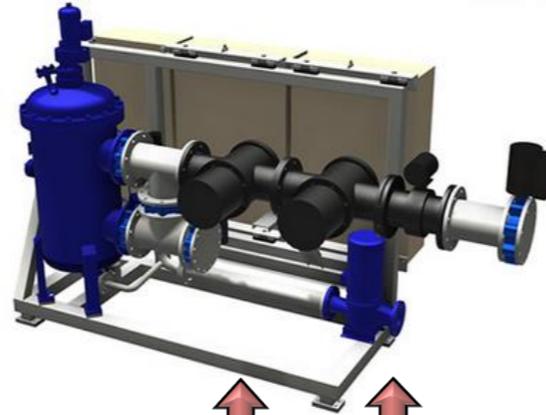
Each is useful *on its own, and*
as *part* of the whole architecture

Example 2: *Ballast-water treatment systems*

Coming regulations require ships to *remove organisms* from ballast water.



Filtration + UV solution →



> Treatment technology type and symbol

Mechanical

1. Cyclonic separation (hydrocyclone)
2. Filtration



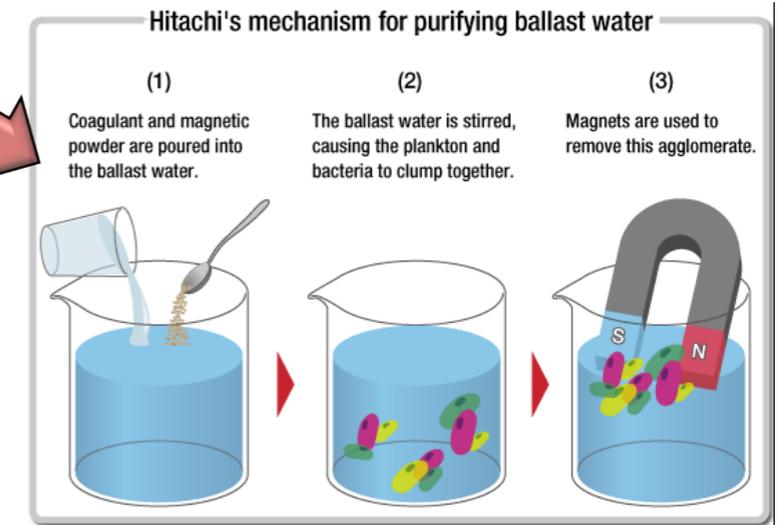
Physical disinfection

1. Coagulation/flocculation
2. Ultrasound
3. Ultraviolet
4. Heat
5. Cavitation
6. Deoxygenation
7. Electro-chlorination/electrolysis
8. Electro-catalysis
9. Ozonation



Chemical treatment and biocides

1. Chlorination
2. Chloride dioxide
3. Advanced oxidation
4. Residual control (sulphite/bisulphate)
5. Peraclean Ocean



Example 2: *Ballast-water treatment systems* *



Coming regulations require ships to *remove organisms* from ballast water **

~*35 approved systems* from 50+ suppliers (5-man teams up to Siemens!)

57,000 vessels worldwide + *2-3,000 new builds* per year *minus scrap*

The challenge ...

How to capture *ship-operators'* decisions on which system to deploy

... and achieve *rapid installation* in their fleets

plus capture BWT installations in *new vessels*

* with permission of Håvard Gjølseth, CEO: [MMC Green Technology](#)

** See [International Maritime Organisation: Ballast Water Management](#)

Customer and *product* profile in ballast-water treatment retro-fit systems



Number of vessels	<i>Companies</i>
> 100	70
50-99	230
20-49	1,450
10-19	1,550
< 10	>25,000

<i>System throughput</i>	Equipment price	Market potential units
100 m ³ /h	€75,000	1,000s
300 m ³ /h	€125,000	1,000s
600 m ³ /h	€225,000	100s
1000 m ³ /h	€365,000	100s
5000 m ³ /h	€1,100,000	10's

No supplier can successfully offer all necessary *products* to serve all *customer segments* and sizes in this industry
... so need to **focus!**

Questions in the *time-phased action-plan* for a Ballast-water treatment system provider



Which size(s) of *vessels* to target?

How many *models* of system to develop, when?

How much effort to win how many *agents* to promote our systems?

How many *sales people* to deploy?

Focus on *new* customers or *repeat sales*?

What *price(s)* to charge on which systems to which sectors?

How many *engineers* to employ? (Production is out-sourced, but need project management and commissioning)

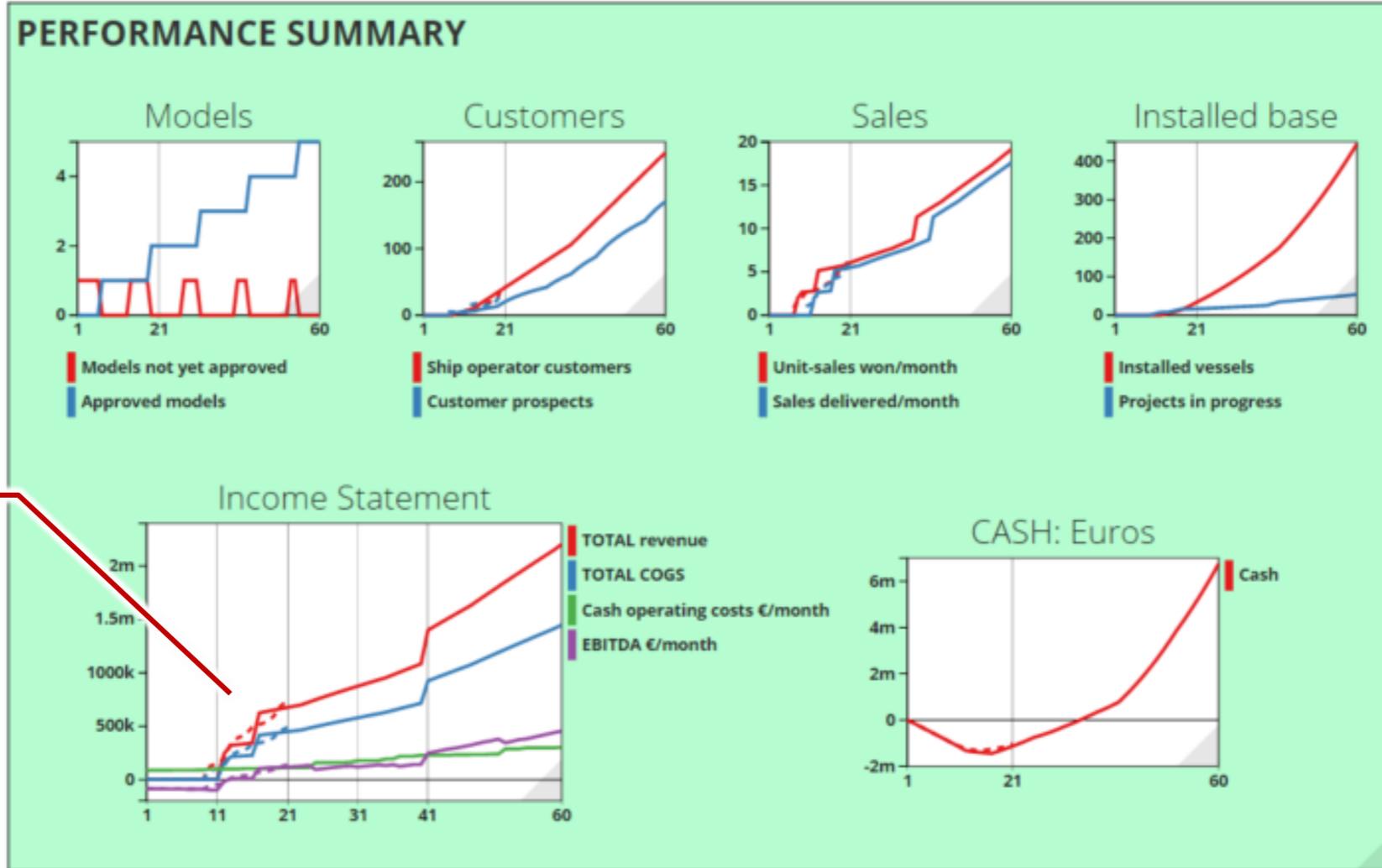
How much *investment* is needed, what *profits* will arise, how will *cash-flow* grow?

All these questions arise continually, as the market and competition develop and as we experience success or failure

BWTS manufacturer *business plan*

months 1-21 history: months 22-60 objectives

Working model at
<http://sdl.re/BWTS>



- - - *dashed* = actual
solid = calculated

The *strategic architecture* of a BWTS producer

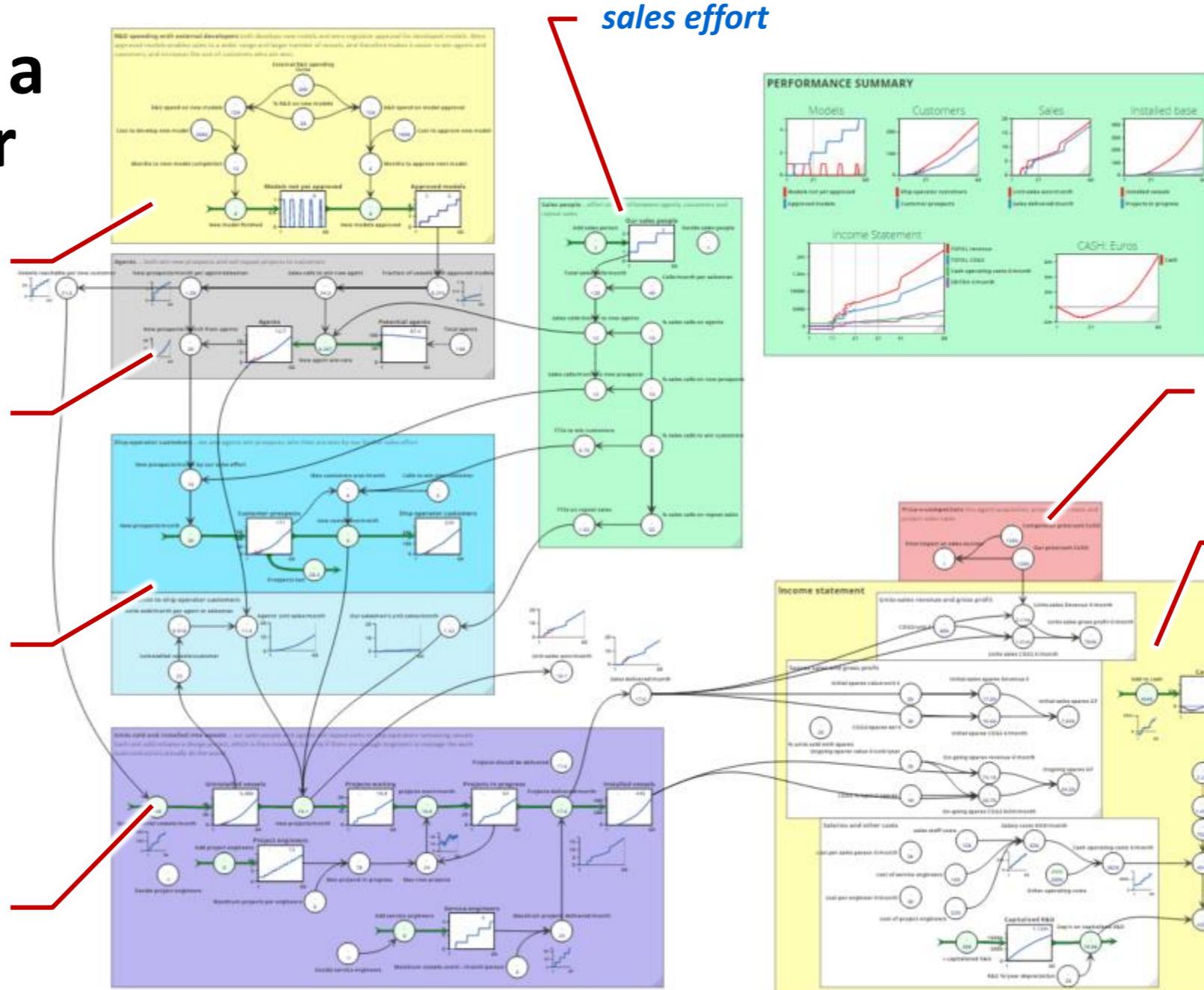


R&D and system *models*

Agents

Customers and *sales*

Projects, *installations* and *engineers*



sales effort

price and competition

Income Statement and cash flow



See also:

Free recording of a short course using these slides sdl.re/agilecourse

How to build models with this method ... sdl.re/sygfull

Case example sdl.re/BWTcase (marine engineering)

The full Strategy Dynamics online course sdl.re/sdcourse

More at www.YouTube.com/strategydynamics and www.strategydynamics.com