

Supplementary Material

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Appendix A – Model Documentation

	Equation	Properties	Units	Documentation
Top-Level Model:				
Growth_trend(t)	$\text{Growth_trend}(t - dt) + (\text{Growth_trend_flow}) * dt$	INIT Growth_trend = Initial_growth_trend	Dimensionless	How well the organisation is growing. 1 means growing as well as you can be, 0 means no growth, -1 means lose as much as possible.

Level_of_employee_conformity(t)	$\text{Level_of_employee_conformity}(t - dt) + (\text{Conformity_gain}) * dt$	INIT $\text{Level_of_employee_conformity} = \text{Initial_Level_of_Conformity}$	Conformity fraction	At equilibrium confidence (1), level of conformity should be 0,2. Below that, decisions made by management are met with increased and not necessarily fruitful scrutiny by employees. Above that, decisions are not met with an increasingly less scrutiny, which will be come more and more unhealthy, because decisions are made in an echo chamber.
Management_Confidence(t)	$\text{Management_Confidence}(t - dt) + (\text{Confidence_gain} - \text{Confidence_depletion}) * dt$	INIT $\text{Management_Confidence} = \text{Initial_Management_Confidence}$	Confidence	A stock of a level between 0 and 2. 1 is healthy business operations. Level 2 is entirely lack of self criticism. Level 0 is so low that the business cannot maintain operations.

Tasks(t)	$\text{Tasks}(t - dt) + (\text{Inflow_of_tasks} - \text{Task_completion}) * dt$	INIT Tasks = Initial_Tasks	Task	Task level in the organisation. Task level should be in equilibrium at the chosen normal task level. If the task level is higher than the normal task level, this represents a scenario where employees are doing some mixture of tasks that do not generate growth. If task level is below normal task level, it represents a scenario where capacity is not utilised to the fullest.
Worker_satisfaction(t)	$\text{Worker_satisfaction}(t - dt) + (\text{Satisfaction_flow}) * dt$	INIT Worker_satisfaction = Initial_worker_satisfaction	Satisfaction units	The level of satisfaction among workers. A level of 1 is required for normal operations
Workers(t)	$\text{Workers}(t - dt) + (\text{Hiring} - \text{Attrition}) * dt$	INIT Workers = Initial_Workers	Workers	Stock of current company workers

Attrition	IF Management_confidence_relative_to_normal < 1 THEN Normal_fractional_attrition*Workers*" Effect_of_relative_management_confidence_<_1_on_attrition"*Effect_of_worker_satisfaction_on_attrition ELSE Normal_fractional_attrition*Workers*" Effect_of_relative_management_confidence_>_1_on_attrition"*Effect_of_worker_satisfaction_on_attrition		Workers/Months	The pressure exerted on employees from various internal sources which will lead them to quit early. Excludes "natural" employee turnover.
Confidence_depletion	Management_Confidence*Normal_confidence_depletion_rate*Effect_from_perceived_negative_feedback_on_confidence_depletion		Confidence/Months	Confidence depletion depends on received negative feedback as a multiplier on the normal confidence depletion rate.
Confidence_gain	Normal_confidence_gain_rate*Effect_from_perceived_positive_feedback_on_confidence_gain*Growth_trend*Effect_of_Conformity_level_on_Management_		Confidence/Months	

	Confidence* ((Maximum_management_confidence- Management_Confidence)/Maximum_ management_confidence)			
Conformity_gain	(Indicated_conformity_level- Level_of_employee_conformity)/Conformity_adjustment_time		Conformity fraction/Months	
Growth_trend_flow	IF Scenario_1:_More_attentive_to_changes_in_company_Growth_Trend_as_an_indicator_of_business_health = 0 THEN(Indicated_growth_trend- Growth_trend)/Growth_trend_adjustment_time ELSE (Indicated_growth_trend- Growth_trend)/Scenario_1_Growth_trend_adjustment_time		1/Months	Biflow of growth trend.
Hiring	MAX((Desired_workers- Workers)/Hiring_adjustment_time; 0)		Workers/Months	Hiring inflow.

Inflow_of_tasks	$\text{Normal_tasks_per_month} + \text{Indicated_unpaid_tasks_per_month}$		Task/ Month	Inflow of tasks is given by adding indicated unpaid tasks to normal tasks per month.
Satisfaction_flow	$(\text{Indicated_satisfaction} - \text{Worker_satisfaction}) / \text{Satisfaction_adjustment_time}$		Satisfaction units/ Months	Satisfaction biflow.
Task_completion	$\text{MIN}(\text{Task_capacity_per_month}; \text{Task_pool_per_month})$		Task/ Month	Task outflow as a result of work done by workers.
"Pool_vs._Capacity_difference_per_month"	$\text{Task_pool_per_month} - \text{Task_capacity_per_month}$		Task/ Month	The difference between task pool and task capacity gives us a number that can be related to how much under or overcapacity of workers we have.
"Actual_tasks/_Normal_tasks_multiplier"	$\text{Task_pool_per_month} / \text{Normal_tasks_per_month}$		Dimensionless	This multiplier feeds into growth function and worker function to give the system a level of tasks relative to normal.

Base_Scenario_Level_of_conformity	1		Conformity fraction	Base run Level of conformity value.
Base_Scenario_Management_Confidence	1,99		Confidence	Base run Management Confidence value
Conformity_adjustment_time	1		Months	
Conformity_level_at_maximum_management_confidence	1		Conformity fraction	If management confidence is 2, level of conformity should be 1.
Desired_workers	"Actual_tasks_/Normal_tasks_multiplier"*Normal_amount_of_workers		Workers	The desired workers considering normal tasks and a level of 150 tasks per worker per month and actual tasks.
Effect_from_perceived_negative_feedback_on_confidence_depletion	LOGISTICBOUND(0; 2; Perceived_negative_feedback/Monthly_feedback_amount; 0,5; "Feedback_S-curve_multiplier"; 0; 1)		Dimensionless	If the amount of negative feedback relative to the total feedback is more than the positive feedback, the confidence depletion increases, and vice versa.

				This was originally a graphical function with the values: <table><tr><td>0,000</td><td>0,000</td></tr><tr><td>0,100</td><td>0,02526</td></tr><tr><td>0,200</td><td>0,08682</td></tr><tr><td>0,300</td><td>0,2331</td></tr><tr><td>0,400</td><td>0,5352</td></tr><tr><td>0,500</td><td>1,000</td></tr><tr><td>0,600</td><td>1,465</td></tr><tr><td>0,700</td><td>1,767</td></tr><tr><td>0,800</td><td>1,913</td></tr><tr><td>0,900</td><td>1,975</td></tr><tr><td>1,000</td><td>2,000</td></tr></table> This has been replaced with an optimised LOGISTICBOUND function. The feedback S-curve multiplier allows sensitivity analysis over the shape of the function.	0,000	0,000	0,100	0,02526	0,200	0,08682	0,300	0,2331	0,400	0,5352	0,500	1,000	0,600	1,465	0,700	1,767	0,800	1,913	0,900	1,975	1,000	2,000
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1,000	2,000																									
Effect_from_perceived_positive_feedback_on_confidence_gain	LOGISTICBOUND(0; 2; Perceived_positive_feedback/Monthly_feedback_amount; 0,5; "Feedback_S-curve_multiplier"; 0; 1)		Dimensionless	If the amount of positive feedback relative to the total feedback is more than the negative feedback, the																						

				confidence gain increases, and vice versa. This was originally a graphical function with the values: 0,000 0,000 0,100 0,02526 0,200 0,08682 0,300 0,2331 0,400 0,5352 0,500 1,000 0,600 1,465 0,700 1,767 0,800 1,913 0,900 1,975 1,000 2,000 This has been replaced with an optimised LOGISTICBOUND function. The feedback S-curve multiplier allows sensitivity analysis over the shape of the function.
Effect_from_work er_satisfaction_on _perceived_positi ve_feedback	GRAPH(Normalised _worker_satisfactio n) Points: (0,000, 0,0000), (0,100, 0,0500), (0,200,		Dimen sionles s	As worker satisfaction decreases from 1, less and less feedback that is

	0,1000), (0,300, 0,1500), (0,400, 0,2000), (0,500, 0,2500), (0,600, 0,3000), (0,700, 0,3500), (0,800, 0,4000), (0,900, 0,4500), (1,000, 0,5000)			positive is perceived.
Effect_of_Conformity_level_on_Management_Confidence	GRAPH(Level_of_employee_conformity) Points: (0,000, 0,000), (0,100, 0,500), (0,200, 1,000), (0,300, 1,117), (0,400, 1,268), (0,500, 1,500), (0,600, 1,732), (0,700, 1,883), (0,800, 1,957), (0,900, 1,987), (1,000, 2,000)		1	If level of conformity is below 0,2, it should indicate a confidence below 1. If level of conformity is 0,2, it should indicate a confidence of 1. If level of conformity is above 0,2, it increases confidence decreasingly.
Effect_of_conformity_level_on_satisfaction	Level_of_employee_conformity/Conformity_level_at_maximum_management_confidence		Dimensionless	At high levels of conformity, this supersedes satisfaction from other indicators. This function passes fraction of conformity onto the indicated satisfaction function.

Effect_of_growth_trend_on_satisfaction	Growth_trend_relative_to_equilibrium		Dimensions	Gives an indication whether we are above or below good growth trend.
"Effect_of_relative_management_confidence_<_1_on_attrition"	GRAPH(Management_confidence_relative_to_normal) Points: (0,000, 2,000), (0,100, 1,800), (0,200, 1,600), (0,300, 1,400), (0,400, 1,200), (0,500, 1,000), (0,600, 0,800), (0,700, 0,600), (0,800, 0,400), (0,900, 0,200), (1,000, 0,000)		Dimensions	If relative management confidence is less than or equal to 1, linearly increase effect on attrition.
"Effect_of_relative_management_confidence_>_1_on_attrition"	GRAPH(Management_confidence_relative_to_normal) Points: (1,000, 0,000), (1,100, 0,200), (1,200, 0,400), (1,300, 0,600), (1,400, 0,800), (1,500, 1,000), (1,600, 1,200), (1,700, 1,400), (1,800, 1,600), (1,900, 1,800), (2,000, 2,000)		Dimensions	If relative management confidence is greater than or equal to 1, linearly increase effect on attrition.

Effect_of_relative_management_confidence_on_conformity	GRAPH(Management_confidence_relative_to_normal) Points: (0,000, 0,000), (0,200, 0,000), (0,400, 0,000), (0,600, 0,000), (0,800, 0,100), (1,000, 0,200), (1,200, 0,5828), (1,400, 0,672), (1,600, 0,7706), (1,800, 0,8796), (2,000, 1,000)		Dimensions	If management confidence is below 1, it indicates a level of conformity below 0,2. If management confidence is 1, it indicates level of conformity of 0,2. If management confidence is above 1, it indicates level of conformity above 0,2
"Effect_of_task_difference/normal_tasks_per_month_on_indicated_satisfaction"	LOGISTICBOUND(1; 0; ABS("Task_difference/_Normal_tasks_per_month"); 0,5; "Task_effect_S-curve_multiplier"; 0; 1)		1	Normal tasks per month represents the ideal level of work. Above that, workers are doing work that is not necessary. This negatively effects worker satisfaction due to feeling work is meaningless. Below that, workers are idle at work, which negatively effects worker satisfaction due to time wastage.

			The resultant effect is the same at both sides of the coin, hence the absolute function. This function is a replacement of an original graphical, s-shaped function with the following table values: <table><tr><td>0,000</td><td>1,000</td></tr><tr><td>0,100</td><td>0,9874</td></tr><tr><td>0,200</td><td>0,9566</td></tr><tr><td>0,300</td><td>0,8835</td></tr><tr><td>0,400</td><td>0,7324</td></tr><tr><td>0,500</td><td>0,500</td></tr><tr><td>0,600</td><td>0,2676</td></tr><tr><td>0,700</td><td>0,1165</td></tr><tr><td>0,800</td><td>0,04341</td></tr><tr><td>0,900</td><td>0,01263</td></tr><tr><td>1,000</td><td>0,000</td></tr></table> The task effect S-curve multiplier allows sensitivity analysis over the shape of the function. Current S-curve multiplier found by	0,000	1,000	0,100	0,9874	0,200	0,9566	0,300	0,8835	0,400	0,7324	0,500	0,500	0,600	0,2676	0,700	0,1165	0,800	0,04341	0,900	0,01263	1,000	0,000
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0,700	0,1165																								
0,800	0,04341																								
0,900	0,01263																								
1,000	0,000																								

				calibration/optimisation.
Effect_of_worker_satisfaction_on_attrition	GRAPH(Normalised_worker_satisfaction) Points: (0,000, 2,000), (0,100, 1,987), (0,200, 1,957), (0,300, 1,883), (0,400, 1,732), (0,500, 1,500), (0,600, 1,268), (0,700, 1,117), (0,800, 1,043), (0,900, 1,013), (1,000, 1,000)		Dimensions	The less satisfied the workers in the organisation are, the more of them at leaving.
"Effect_on_growth_trend_due_to_actual_tasks/_normal_tasks_multiplier_<_1"	GRAPH("Actual_tasks/_Normal_tasks_multiplier") Points: (0,000, -1,000), (0,100, -0,800), (0,200, -0,600), (0,300, -0,400), (0,400, -0,200), (0,500, 0,000), (0,600, 0,200), (0,700, 0,400), (0,800, 0,600), (0,900, 0,800), (1,000, 1,000)		1	If the input from tasks indicate that the organisation is doing less tasks than the normal level of tasks, it indicates a lower level of growth trend.
"Effect_on_growth_trend_due_to_actual_tasks/_normal_tasks_multiplier_>_1"	GRAPH("Actual_tasks/_Normal_tasks_multiplier") Points: (1,000, 1,000), (1,100, 0,800), (1,200, 0,600), (1,300, 0,400),		1	If the input from tasks indicate that the organisation is doing more tasks than the normal level of

	(1,400, 0,200), (1,500, 0,000), (1,600, -0,200), (1,700, -0,400), (1,800, -0,600), (1,900, -0,800), (2,000, -1,000)			tasks, it indicates a lower level of growth trend
Equilibrium_SWITCH	0		Dimensionless	Set the model in equilibrium
Feedback_per_worker_per_month	0,12		Worker Feedback Units/worker/month	Depending on specific circumstances, feedback generate per worker on average can vary quite a lot. This adjusts that.
"Feedback_S-curve_multiplier"	9,609375		Dimensionless	Controls the "effect from perceived positive/negative feedback on confidence gain/depletion" S-curve shape, replacing a graphical function and permitting sensitivity analysis over its shape. Initial value determined by optimisation to

				an identical graphical function.
"Feedback_weighting_(in_positive_direction)"	Management_Confidence/Maximum_management_confidence		Dimensionless	This is a weighting function. In equilibrium, it means that the system listens to equal amounts of positive and negative feedback. In high levels of confidence, negative feedback is ignored. In low levels of confidence, positive feedback is ignored.
Growth_trend_adjustment_time	6		Months	
Growth_trend_at_equilibrium	1		Dimensionless	
Growth_trend_relative_to_equilibrium	Growth_trend/Growth_trend_at_equilibrium		1	
Hiring_adjustment_equation	(Minimum_hiring_adjustment_time-Maximum_hiring_adjustment_time)*Normalised_worker_		Months	Linear hiring adjustment equation in the form of $ax+b$.

	satisfaction+Maximum_hiring_adjustment_time			a represents the slope, which is given by minimum hiring adjustment time - maximum. b is given by the maximum hiring adjustment time. x is the normalised worker satisfaction. This equation replaces a functionally identical graphical variable, and thus permits sensitivity analysis.
Hiring_adjustment_time	MIN(Maximum_hiring_adjustment_time; (MAX(Minimum_hiring_adjustment_time; Hiring_adjustment_equation)))		Months	Depending on worker satisfaction, it is harder to get people in the door. Potential workers generally seek improvement of own conditions. As worker satisfaction goes very low, the

				pool of potential workers whose current situation is worse than working at this company dwindles.
Indicated_conformity_level	Conformity_level_at_maximum_management_confidence* Effect_of_relative_management_confidence_on_conformity		Conformity fraction	Indicated level of conformity relative to maximum level of conformity.
Indicated_growth_trend	IF "Actual_tasks_/Normal_tasks_multiplier" = 1 THEN "Actual_tasks_/Normal_tasks_multiplier"*Normalised_worker_satisfaction ELSE IF "Actual_tasks_/Normal_tasks_multiplier" > 1 THEN "Effect_on_growth_trend_due_to_actual_tasks_/normal_tasks_multiplier_>_1" ELSE "Effect_on_growth_trend_due_to_actual_tasks_/normal_tasks_multiplier_<_1"		Dimensionless	Growth trend relay mostly on how many tasks the organisation is doing relative to the normal tasks per month. If above or below that, there is growth less than 1. The IF function selects to appropriate effect based on where the system is.

Indicated_satisfaction	IF Max_satisfaction*Effect_of_conformity_level_on_satisfaction > ((Max_satisfaction*("Effect_of_task_difference/normal_tasks_per_month_on_indicated_satisfaction"+Effect_of_growth_trend_on_satisfaction))/2) THEN Effect_of_conformity_level_on_satisfaction*Max_satisfaction ELSE (Max_satisfaction*("Effect_of_task_difference/normal_tasks_per_month_on_indicated_satisfaction"+Effect_of_growth_trend_on_satisfaction))/2		Satisfaction units	If the satisfaction coming from the level of conformity is higher than the average satisfaction coming from growth trend and task imbalance, then use satisfaction from level of conformity. If it is lower, use the average.
Indicated_unpaid_tasks_per_month	(Normal_tasks_per_month*Management_confidence_relative_to_normal)-Normal_tasks_per_month		Task/ Month	Tasks that are surplus to tasks required to have growth of 1. Indicated based on relative management confidence.
Initial_growth_trend	1		Dimensionless	

Initial_Level_of_Conformity	IF Equilibrium_SWITCH = 1 THEN Normal_Level_of_Conformity ELSE Base_Scenario_Level_of_Conformity		Conformity fraction	
Initial_Management_Confidence	IF Equilibrium_SWITCH = 1 THEN Normal_management_confidence_level ELSE Base_Scenario_Management_Confidence		Confidence	
Initial_Tasks	15000		Task	
Initial_worker_satisfaction	1		Satisfaction units	
Initial_Workers	100		Workers	
Management_confidence_relative_to_normal	Management_Confidence/Normal_management_confidence_level		Dimensionless	Number which determines if management confidence is above or below normal.
Max_satisfaction	1		Satisfaction units	Maximum satisfaction level.
Maximum_hiring_adjustment_time	9		Months	The maximum time in months it is possible for

				hiring to take, considering a normalised worker satisfaction of 0.
Maximum_management_confidence	2		Confidence	Maximum level of management confidence.
Minimum_hiring_adjustment_time	3		Months	The maximum time in months it is possible for hiring to take, considering a normalised worker satisfaction of 0.
Minimum_worker_satisfaction	1		Satisfaction units	Below this level, worker satisfaction will start impacting other parts of the system
Monthly_feedback_amount	$\text{Feedback_per_worker_per_month} * \text{Workers}$		Worker Feedback Units/month	The total amount of feedback in a month
Normal_amount_of_workers	100		Workers	The normal amount of workers is the static level of workers which is optimal for the system. By not coupling it to

				initial workers, the model can be initialised at a worker level above optimal.
Normal_confidence_depletion_rate	0,04		1/Months	Normal rate at which confidence is drained.
Normal_confidence_gain_rate	0,08		Confidence/Months	Normal rate at which confidence is gained
Normal_fractional_attrition	0,05		1/Months	Represents the base rate of attrition if not in equilibrium. Considers multiple types of position, for example summer internships, short term, fixed full time etc.
Normal_Level_of_conformity	0,2		Conformity fraction	The level of conformity where the business is running well.
Normal_management_confidence_level	1		Confidence	The level of management confidence where the

				business is running well.
Normal_tasks_per_month	15000		Task/ Month	The level of tasks which produce the strongest growth. Must normal amount of workers and normal tasks per worker per month.
Normal_tasks_per_worker_per_month	150		Task/w orker/ month	Based on 1 task per hour. 7,5h working days. 20 working days in a month.
Normalised_worker_satisfaction	Worker_satisfaction /Minimum_worker_satisfaction		Dimen sionles s	Worker satisfaction relative to minimum worker satisfaction
Perceived_negative_feedback	Monthly_feedback_amount- Perceived_positive_feedback		Worke r Feedb ack Units/ month	The part of monthly feedback amount which is negative.
Perceived_positive_feedback	IF Scenario_2:_Feedba ck_weighting_sourc e_replacement = 0 THEN Monthly_feedback_ amount*"Feedback		Worke r Feedb ack Units/ month	The part of monthly feedback amount which is positive.

	$_weighting_ (in_positive_direction)"$ ELSE $Monthly_feedback_amount * Effect_from_worker_satisfaction_on_perceived_positive_feedback$			
Satisfaction_adjustment_time	3		Months	
Scenario_1_Growth_trend_adjustment_time	3		Months	Scenario 1 alternative growth trend adjustment time
Scenario_1:_More_attentive_to_changes_in_company_Growth_Trend_as_an_indicator_of_business_health	0		Dimensionless	Policy switch
Scenario_2:_Feedback_weighting_source_replacement	0		Dimensionless	Policy switch
Task_capacity_per_month	Workers*Normal_tasks_per_worker_per_month		Task/Month	The maximum tasks that may be completed per month considering current staff level.
Task_completion_adjustment_time	1		Month	

"Task_difference/_ Normal_tasks_per _month"	"Pool_vs._Capacity_ difference_per_mo nth"/Normal_tasks_ per_month		Dimen sionles s	Relative number representing the difference between how many tasks are being completed and the normal level of tasks, which gives the strongest growth.
"Task_effect_S- curve_multiplier"	9,609375		Dimen sionles s	Controls the "effect of task difference on indicated satisfaction" S- curve shape, replacing a graphical function and permitting sensitivity analysis over its shape. Initial value determined by optimisation to an identical graphical function.
Task_pool_per_m onth	Tasks/Task_complet ion_adjustment_ti me		Task/ Month	The total amount of tasks that are available to be completed in a month.

Threshold	1		Confidence	
Threshold_difference	$(\text{Management_Confidence} - \text{Threshold})^2$		Confidence^2	For optimisation purposes. The more the management confidence stock moves away from the threshold, the worse the difference.
" $\gamma=0,2$ "	0,2		Dimensionless	
" $\gamma=1$ "	1		Dimensionless	
" $\gamma=100$ "	100		Dimensionless	
" $\gamma=15k$ "	15000		Dimensionless	

Appendix B – Runs specifications per scenario

The model runs in a time horizon of 120 months (10 years). It uses Euler Integration method with a DT of 32 (for more information, see Appendix C on integration testing).

Run Specs	
Start Time	0
Stop Time	120
DT	1/32
Time Units	Months
Integration Method	Euler

Equilibrium

The model can be placed in equilibrium by turning the Equilibrium SWITCH to 1. The stocks are in their normal or average values.

Equilibrium run settings					
Initial growth trend	Initial management confidence	Initial workers	Initial fraction of conformity	Initial tasks	Initial worker satisfaction
1	1	100	0,2	15000	1

Base run

The base run can be run when all switches (equilibrium, scenario 1, scenario 2) are equal to 0.

Base run settings					
Initial growth trend	Initial management confidence	Initial workers	Initial fraction of conformity	Initial tasks	Initial worker satisfaction
1	1,99	100	1	15000	1

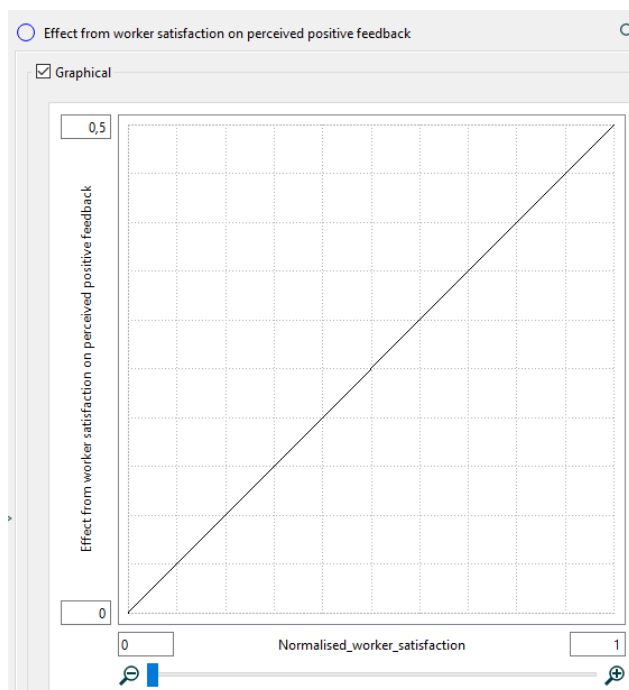
The assumption is that, in the past, the organisation in question had a good level of success. It does things right and it does things well. As good results keep piling up, management confidence in their leadership grows. As time goes on, continued good results and high management confidence silences critical voices, leading to a high level of conformity. The initial success of the company means that money is not a limitation and the company can afford to try to spend itself out of the situation. This is the position we start the model. This is reflected in a very high management confidence (= 1,99), and a corresponding high Conformity (=1).

Scenario 1: More attentive to changes in company's Growth trend as an indicator of business health

This scenario runs with all inputs as in the Base Run, except for Growth Trend adjustment time which is set to 3 months instead of 6 months in Base Run. The scenario is activated by changing to a value of 1 in the variable: Scenario 1: More attentive to changes in company Growth Trend as an indicator of business health.

Scenario 2: Feedback weighing source replacement

In this scenario, the variable Perceived positive feedback is taking as input not the feedback weighting coming from Management Confidence but the Effect_from_worker_satisfaction_on_perceived_positive_feedback:



The effect is assumed to be linear for simplicity. The scenario is activated by changing to a value of 1 the variable: Scenario 2: Feedback weighing source replacement.

Scenario 3: Remaining modest

This scenario is the model in equilibrium run settings. The model will still pull itself out of equilibrium if the Level of employee conformity is above 0,2.

Appendix C – Validation

Integration method and DT testing:

Several tests ranging from DT 1/2 to DT 1/256 was made. Comparison between 1/32 and 1/(64/128/256) showed no mathematical differences of output below DT 1/32.

Experimentation showed no difference in output between Euler and RK2 and RK4 methods, however this model uses the MIN Stella Architect builtin, which could produce unexpected results with RK2 or RK4. (isee systems, n.d)

Sensitivity analysis – local

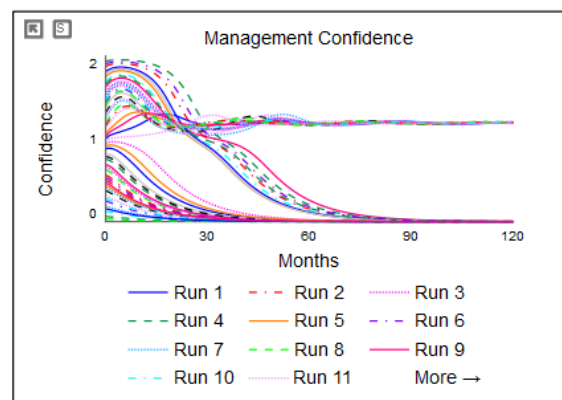
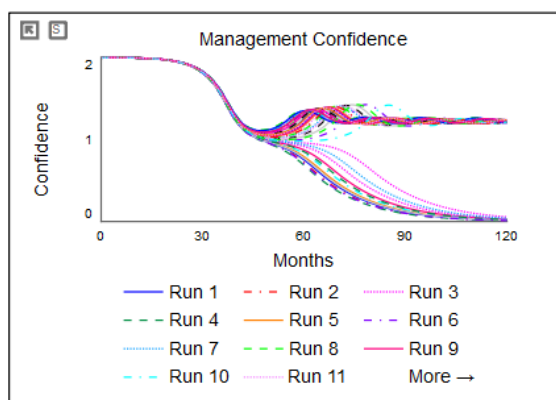
Local sensitivity analysis was conducted in Stella Architect with 50 runs, Sobol sequence sampling and uniform distribution.

Table 1 - Sensitivity analysis results of estimated values.

Table of estimated values			
Area	Variable	Range	Sensitivity
Confidence and Feedback	Normal confidence gain rate	0,02-0,5	Numerical
	Normal confidence depletion rate	0,02-0,5	Inconclusive, Behavioural for value 0,0275
	Normal confidence depletion rate (fine resolution test)	0,02-0,035	Behavioural
	Feedback per worker per month	0,05-1	Inconsequential
	Initial management confidence	0-2	Behavioural
	Feedback S-curve multiplier	0-15	Numerical
Conformity	Initial fraction of conformity	0-1	Numerical
	Conformity adjustment time	1-12	Numerical

Workers	Normal fractional attrition	0,02-0,15	Behavioural
	Maximum hiring adjustment time	9-18	Numerical
	Minimum hiring adjustment time	1-9	Behavioural*
	Maximum + minimum hiring adjustment time (100 runs)	1-18	Behavioural*
Worker satisfaction	Initial worker satisfaction	0-1	Numerical
	Satisfaction adjustment time	1-6	Numerical
	Task effect S-curve multiplier	0-15	Numerical
Growth trend	Growth trend adjustment time	1-12	Behavioural

The given table represents the results of local sensitivity analysis after 50 runs of Sobol sequence sampling with a uniform distribution in the given range. The model is sensitive to 4 parameters. Output shown below, in terms of management confidence stock. Left to right, top to bottom: Normal confidence depletion rate, initial management confidence, normal fractional attrition and growth trend adjustment time.



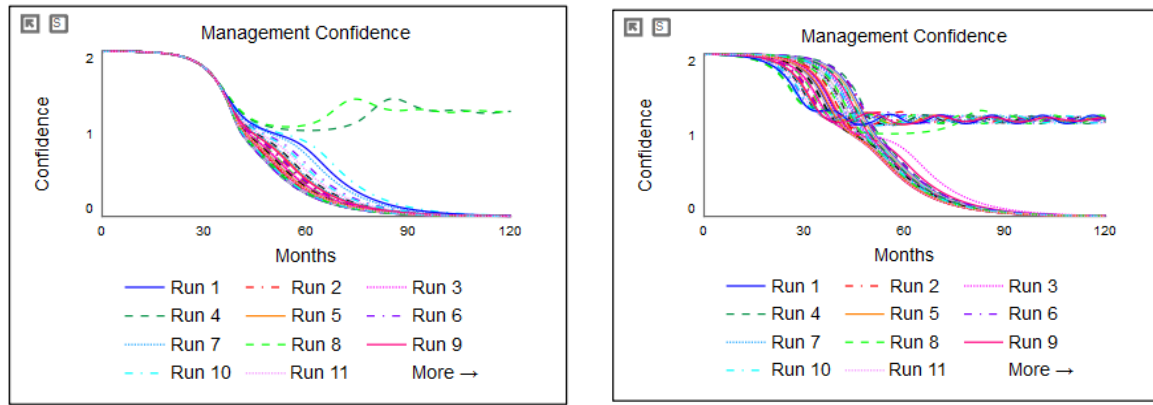


Figure 1 - Local sensitivity analysis results.

The tasks stock is behaviourally sensitive to the minimum hiring adjustment time. If the minimum hiring adjustment time is sufficiently low, it will produce a plateau of around 30 000 tasks from around timestep 7 until around timestep 30. However, it does not behaviourally affect other stocks. The tasks stock still reaches the maximally relevant level, and it is therefore the model is not really sensitive to the minimum hiring adjustment time.

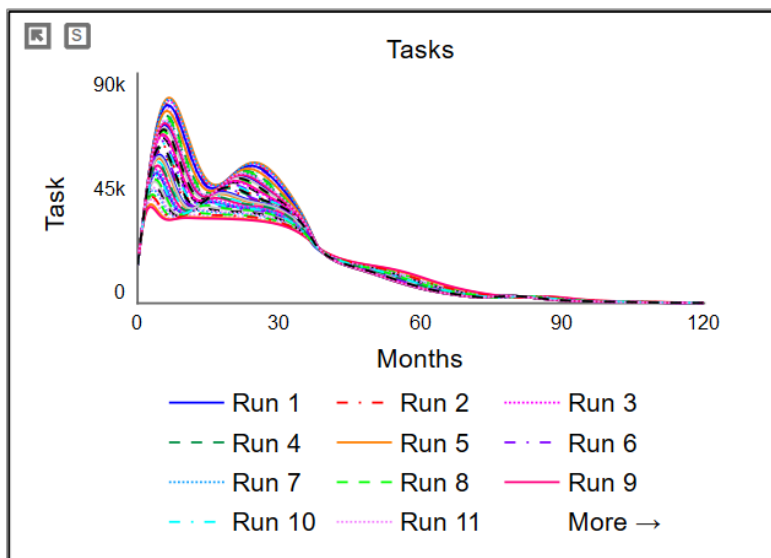


Figure 2 - Local sensitivity analysis of hiring adjustment time.

Sensitivity analysis - Global

Global sensitivity analysis was run with a 1000 run Sobol sequence sampling uniform distribution analysis on all parameters except the Feedback per worker per month which was omitted because it has no bearing on the outcome based on local sensitivity. Range of parameter values is the same as for local sensitivity (see Table 1). Confidence intervals at 50% and 100% as well as median value of all simulations can be seen in Figure 3.

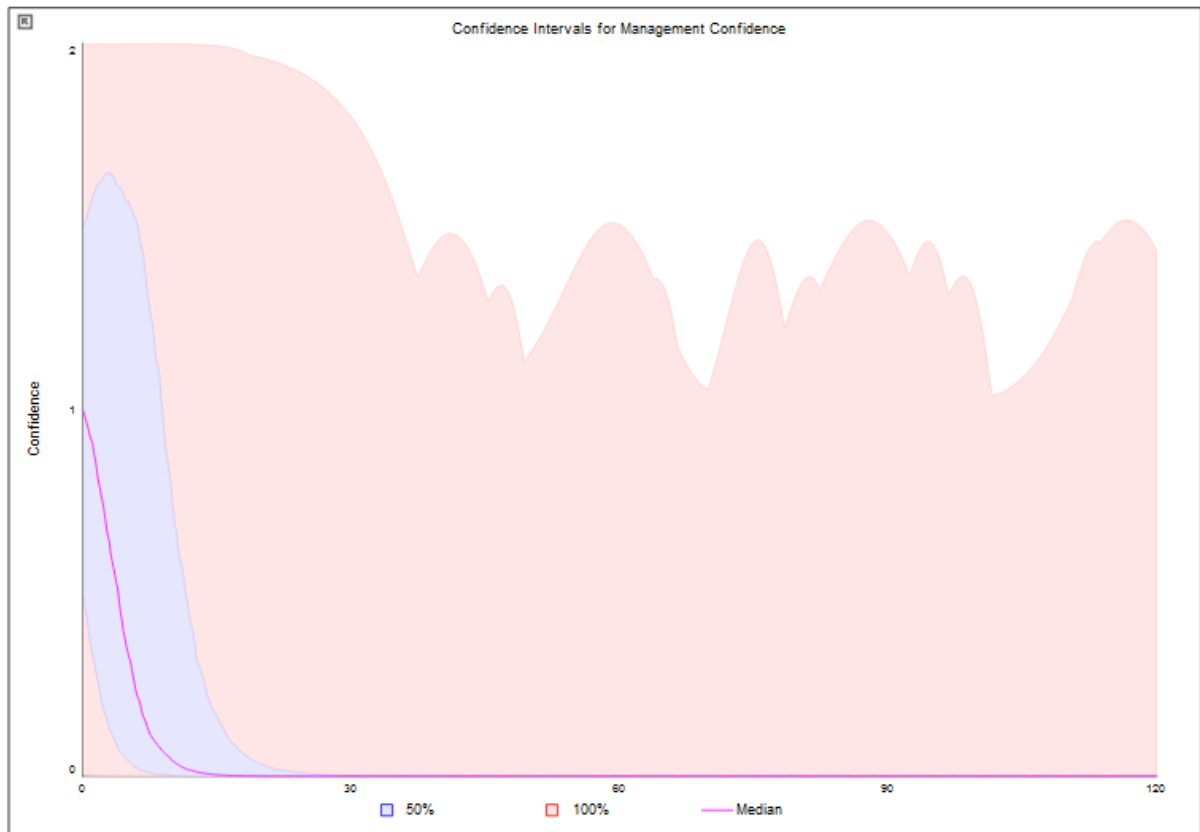


Figure 3 - Confidence plots for managment confidence

The output from the global sensitivity analysis tells us that all scenarios tested lead to collapse, or decline into some volatile oscillatory sustained operation. We are aware that any deviation of management confidence from 1 has undesirable consequences elsewhere, most typically in the growth trend stock.

The conclusion from the global sensitivity analysis is that the only way to win is to never “play the game”. The only way to ensure a good outcome, is to ensure confidence remains at 1.

Extreme condition testing and model adaptation

At high levels of initial confidence, the model should eventually collapse. At initial confidence of 1, model should remain in equilibrium. At initial confidence below 1, model should not increase, but should collapse. At 0, model should flatline. Initial fraction of conformity must match levels of confidence for tests to be valid.

Table 2 - Model setting overview for validation tests.

Basic settings (static)			
Initial growth trend	Initial workers	Initial tasks	Initial worker satisfaction
1	100	15000	1

Table 3 - Extreme condition testing and results.

Tests			
Initial Confidence Value	Initial fraction of conformity value	Result	Pass/review/fail
2	1	Sustained unhealthy equilibrium, see below	Review
1,99	0,99	Collapse	Pass
1	0,2	Equilibrium	Pass
0,9	0,2	Rapid collapse	Pass
0	0	Flatline	Pass

Initial confidence at level 2 represents an extreme condition. In this mode, the task surplus remains high, personnel requirements remain high, conformity remains high because confidence demands it, which then includes reported satisfaction. But growth trend is as low as it possibly could be, because the tasks that bring growth are outcompeted by tasks that are not paid. This represents something similar to a cult.

Integration testing:

Several tests ranging from DT 1/2 to DT 1/256 was made. Comparison between 1/32 and 1/(64/128/256) showed no mathematical differences of output below DT 1/32. Experimentation showed no difference in output between Euler and RK2 and RK4 methods,

however this model uses the MIN Stella Architech builtin, which could produce unexpected results with RK2 or RK4. (isee systems, n.d)