

Banking back office processing behaviour : considerations on a process activity managed by capacity saturation policies.

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Abstract.

This speech proposal describes an example taken from a work-in-progress in which systems dynamics is used to reproduce and simulate some back office activities within a financial organization. The model does not support an initial hypothesis on its own but is meant for the estimation of potential financial losses originating from process behaviour dependent from volumes of items in processing as part of a wider Operational Risk Management exercise. By sampling and reproducing a key process activity, it has been possible to observe how a processing behaviour, optimised on capacity saturation by a traditional BPR approach, presents inefficiencies that are not otherwise intuitively evident. The value of this application is in the modelling of personnel behaviour at changing work pressure and its dynamics and it present some observation regarding the personnel allocated to the activity and the overtime policy.

Key Words

process, HR_policy, operational_risk_management, process_behaviour, banking, back_office, BPR, resource_allocation

Introduction.

In 2001, with the New Basle Accord a new set of regulations concerning Risk Management was applied to banking and financial companies. One of the biggest changes is the newly introduced regulation for Operational Risk management calculations and capital requirements. This kind of risk presents few challenges because of lack of historical data, major inconsistencies of operational characteristics across even similar organisations and its complexity caused by the systemic interaction of different operational layers: processes, people, technology and market events. Risk Management is an established practice on its own but, with the methodologies and approaches developed and used so far, it is inadequate on its own to estimate the financial loss an organisation would incur in case of events effecting its operations. Systems Dynamics is one of the enabling tools understanding of complexity and how different parts of the company interact and determine efficiencies and enabling observations otherwise not available by a process behaviour spreadsheet based approaches. This proposal reports on a model of non-automated back office processing for OTC derivatives products.

The process includes two main Back Office steps: after the trade ticket is received from the Front Office, it undergoes confirmation processing and is then settled before being stored in an electronic file and in a physical folder. In some cases the position (traded financial product) is then utilised for further financial objectives: edged when another financial product is associated to it and their combination provides income or limit market risk or as a collateral when the traded financial product is used as financial base to buy other products.

In most of the major banks back office processes tend to be automated reducing both the amount of paper processing and minimising the cost per processed unit and the errors caused by manual intervention. In smaller organisations the needed investment in technology has been so far considered too expensive due to the limited overall trade volumes and most of these processes are still performed manually. The described model is based on the real process in a small financial organisation where an Operational Risk Management project is currently in progress with the aim of understanding the kind of impact that sudden changes in trade volumes may have on the cost and revenues associated with OTC Derivatives Back Office processing. The impacted revenues are those deriving from the use of the positions as collateral and the losses are determined by the unavailability of the position to be edged or used in conjunction to other financial products for edging purposes. The what-if and sensitivity analysis performed with pulses of incoming tickets have not been reported in this presentation since they were of little interest for the behavioural nature of the reported observations.

The process in consideration has been optimised by a BPR project few years ago with the aim of optimising costs by maximising capacity utilisation while keeping the number of processing errors to a nominal minimum. The outcome of the reengineering is an equilibrium balancing the cost of resources allocated to the activities and the quality of processing. The reported model focuses on the confirmation activity and it is based on on-field measurements that still in progress in order to acquire deeper data granularity needed to achieve a realistic reproduction of the actual performance behaviour¹.

¹ Sampling is currently performed in an informal manner in order to avoid influencing personnel behaviour. The sampling stage is dependent on financial market conditions as trading volumes varies uncontrollably on market events.

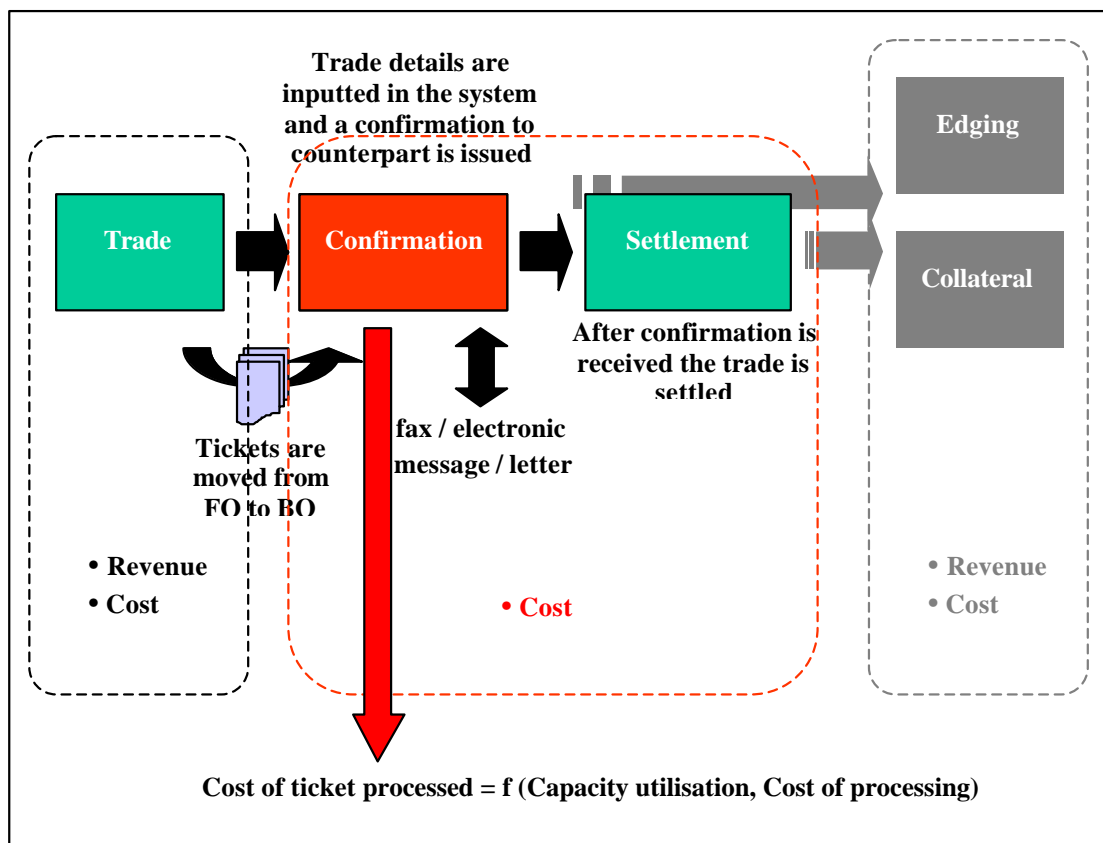


Fig. 1. OTC Derivative Processing.

The activity under consideration is “confirmations” in which the trade ticket is manually checked for errors and then inputted into a clearing system aimed at matching the trade against the one from counterpart. The single ticket processing takes a defined amount of time to be checked carefully and input properly. After being confirmed the trade ticket forwarded for settlement. In case of error, a message is received from the counterpart, with an average delay of eight to sixteen hours². The error is then investigated and the ticket is sent back to confirmation level for re-processing. Some counterpart agreements include fines in case of errors and the total error cost for the bank is further increased by the cost of the extra work needed to correct the error and by the missed earning (or cost saving since risk a cost for a financial organisation) because of the delayed availability of the traded position.

The model explores the effect of variation in traded volumes, resulting in incoming tickets, on the processing behaviours and resulting number of errors determining not only in a potential loss for the bank but a feed back of tickets to be re-processed to the employee in-tray.

² In the model the delay is assumed equal to 12 hours as a total for the actual delay for the counterpart to respond and the investigation time.

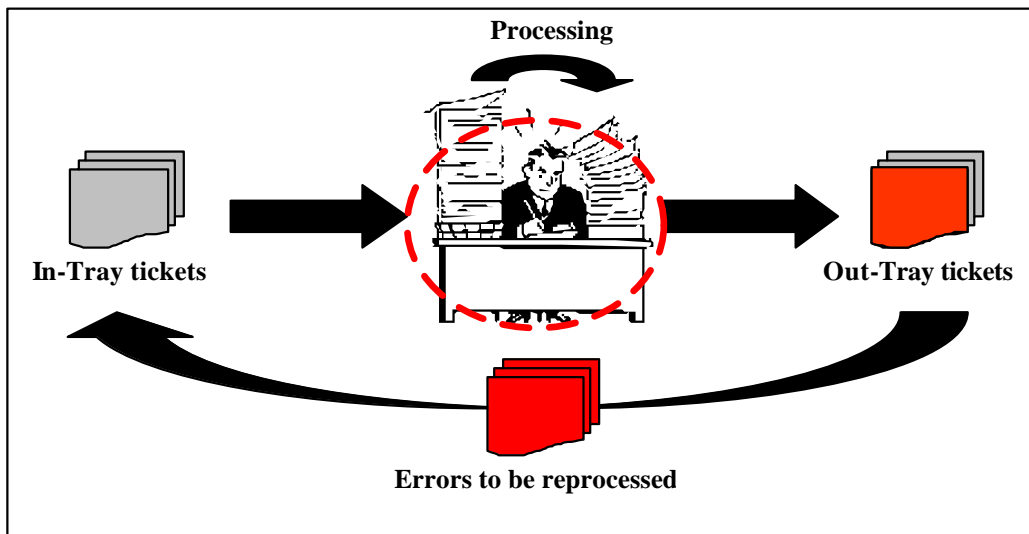


Fig 2. Confirmation processing.

The employee behaviour has been observed to be function of the incoming tickets, the more the tickets the quicker the employee will try to process them in order to reduce the in-tray ticket amount. Fig. 3 shows the behaviour dynamic, the more the volumes, the bigger the cue the less the processing time. The less the processing time, the lower the quality of processing, the more the errors that after a delay came back piling up on top of the cue of tickets to be processed.

Some data within this presentation has been neutralised so to avoid the identification of the financial services organisation and the data has been changed while keeping the meaningful ratios.

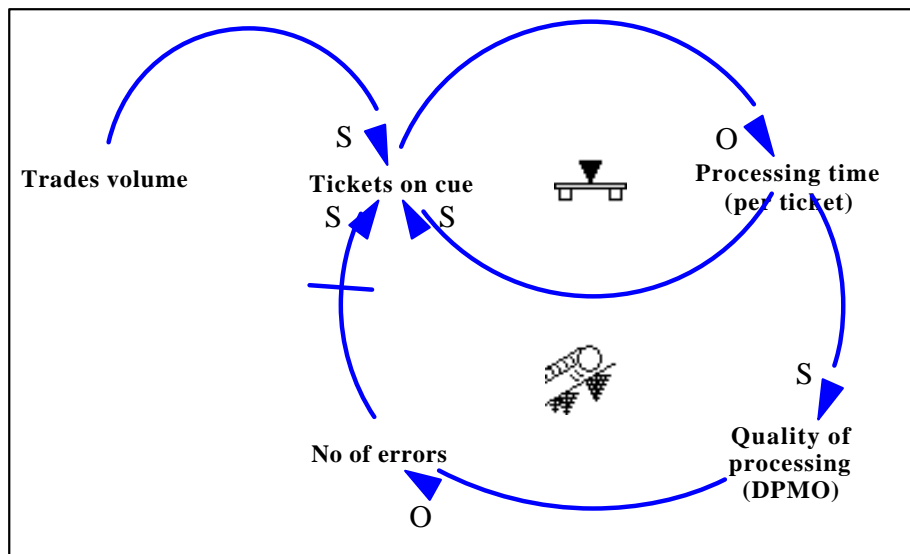


Fig. 3. Confirmation processing dynamics

The simulation model.

Figure 4 shows the simulation model that is currently used to understand the systems behaviour at changing trade volumes. The framed section shown the confirmation processing simulation, with a simplified representation of settlement processing activities that is where errors get found and investigated before being sent back to confirmation for re-processing after a delay.

For the presentation sake, the confirmation activity in the model is assumed to be performed by 1 person.

On filed observations reports a “time spend on each ticket” is recorded. This is a function of the number of the tickets cueing on the In-Tray and the average of collected samples. It is shown in the following table:

	In Tray	8	9	10	11	12	13	14	15	16	17	18	19	20
Average	min, sec	5 5	4 58	5 2	4 51	4 48	4 36	4 38	4 15	4 14	4 4	3 58	4 7	4 3
time	[min]	5.08	4.97	5.03	4.85	4.80	4.60	4.63	4.25	4.23	4.07	3.97	4.12	4.05

The values are the time averages out of a consistent sample out of on field sampling taken during a length of 24 days and within relatively stable market conditions. The first row reports the number of tickets waiting on the In-Tray to be processed. The range goes from 2 to 20 since it is within this range that the significant change of behaviour occurs. Below 8 tickets, the average time is about 5’ 5” and has a constant with variances that are insignificant at statistical level.

The second row shows the times in minutes and second terms while the third row shows the same values in minutes only.

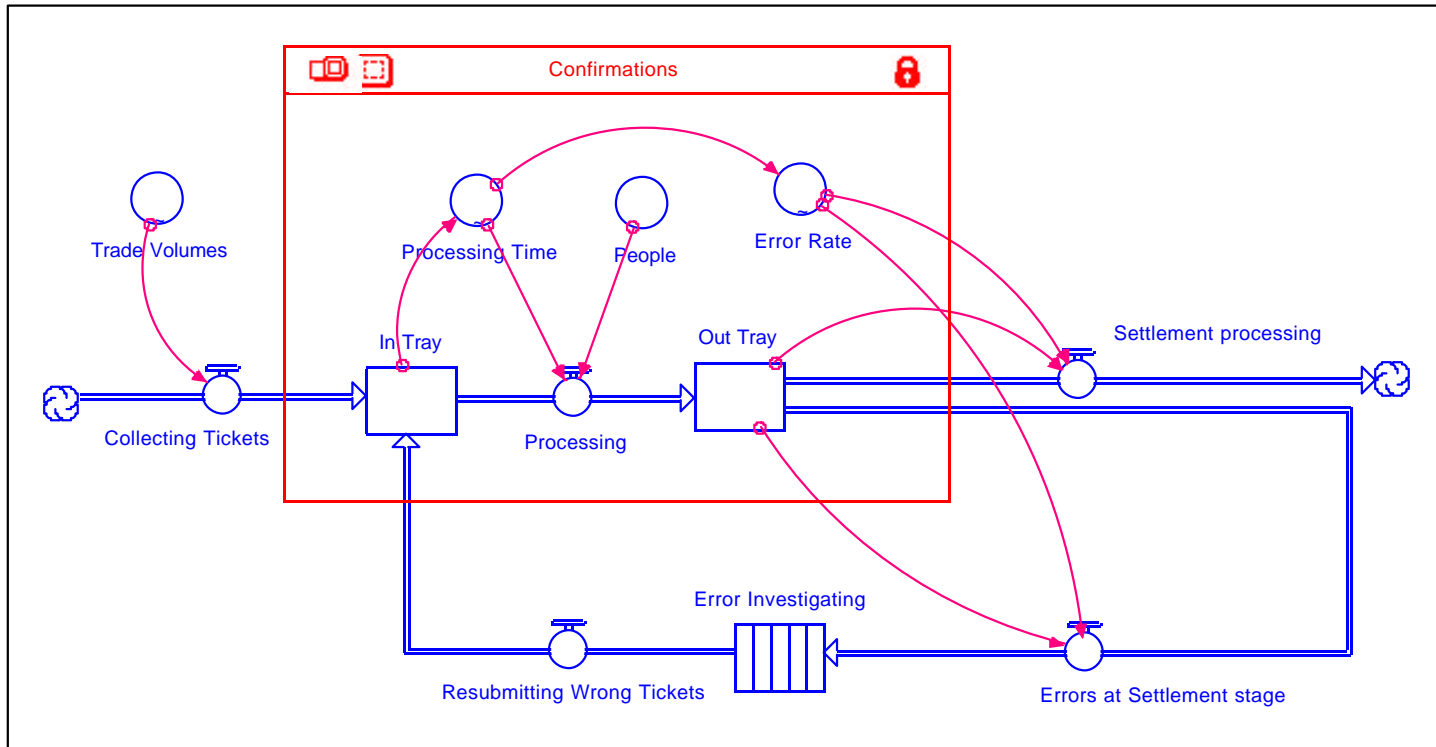
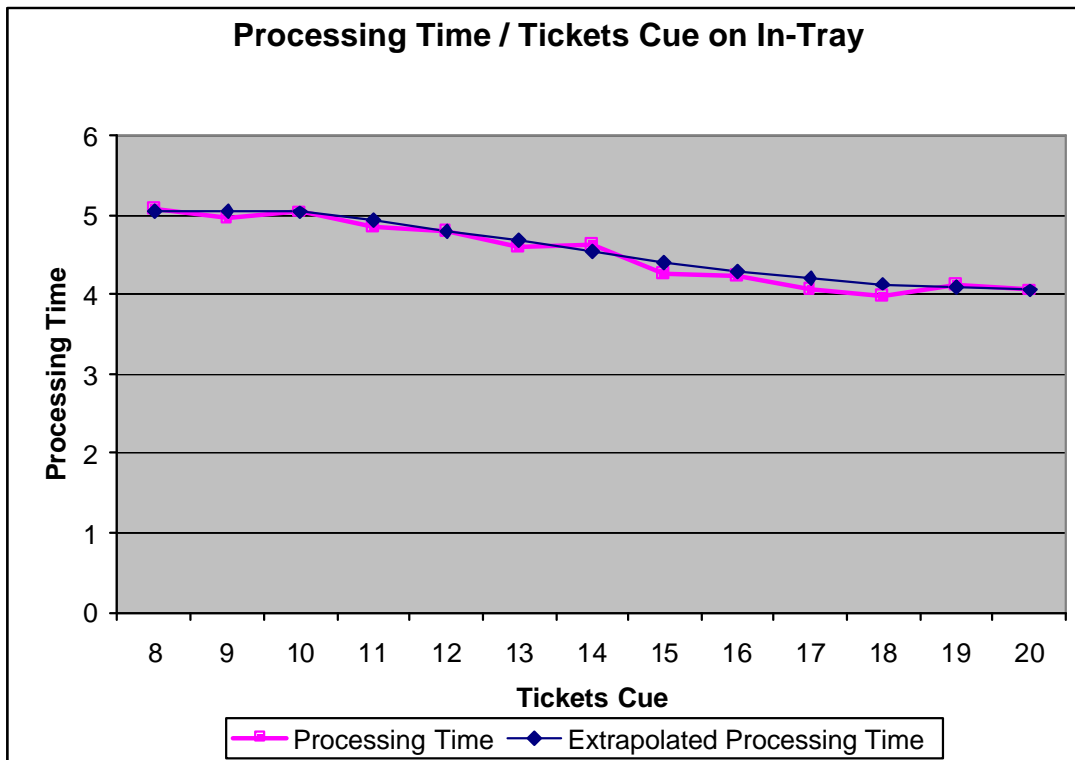


Fig. 4. Simulation model (model equations on appendix 1)

The following graph shows the trend in processing time versus the number of tickets on cue.



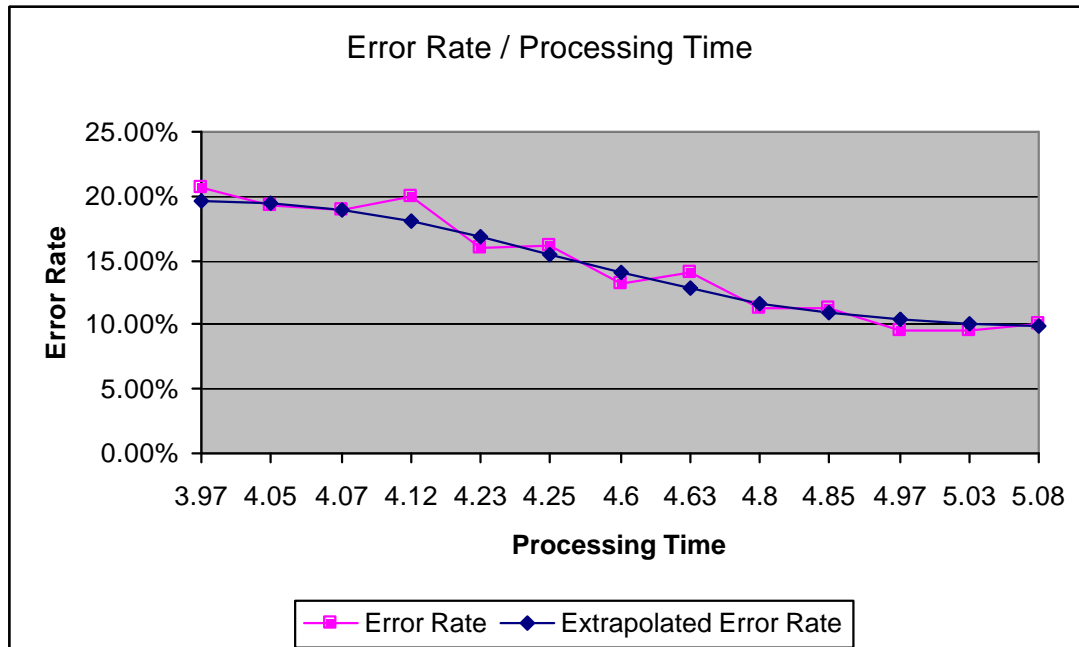
The magenta line reports graphically the average values while the blue one reports the set of values that have been extrapolated from the sample to be used for the simulation. The same times (in minutes) are shown in numeric format in the following table:

Tickets cue	8	9	10	11	12	13	14	15	16	17	18	19	20
Processing Time	5.08	4.97	5.03	4.85	4.8	4.6	4.63	4.25	4.23	4.07	3.97	4.12	4.05
Extrapolated Processing Time	5.05	5.05	5.03	4.93	4.8	4.67	4.54	4.39	4.29	4.2	4.13	4.08	4.05

The sampling then focused on getting an average error rate at the different processing times corresponding to the above-depicted range of tickets on cue. The error range is reported as follows:

Processing Time	3.97	4.05	4.07	4.12	4.23	4.25	4.6	4.63	4.8	4.85	4.97	5.03	5.08
Error Rate (%)	20.70	19.21	18.90	19.93	15.90	16.20	13.12	14.01	11.28	11.31	9.58	9.56	10.02
Extrapolated Error Rate (%)	19.60	19.40	18.90	18.10	16.90	15.40	14.10	12.80	11.70	10.90	10.40	10.10	9.96

As before, out of the average error rate corresponding to the average processing time per ticket, the model uses an extrapolated serie of values. The actual error rates and the extrapolated ones are graphically shown in the following diagram:



The model is based on the incoming number of tickets /day in a week period in which market activity is within norm, without any particular events creating any sudden movements of capitals. Back Office has 10 hours of actual operations, (typical) overtime included.

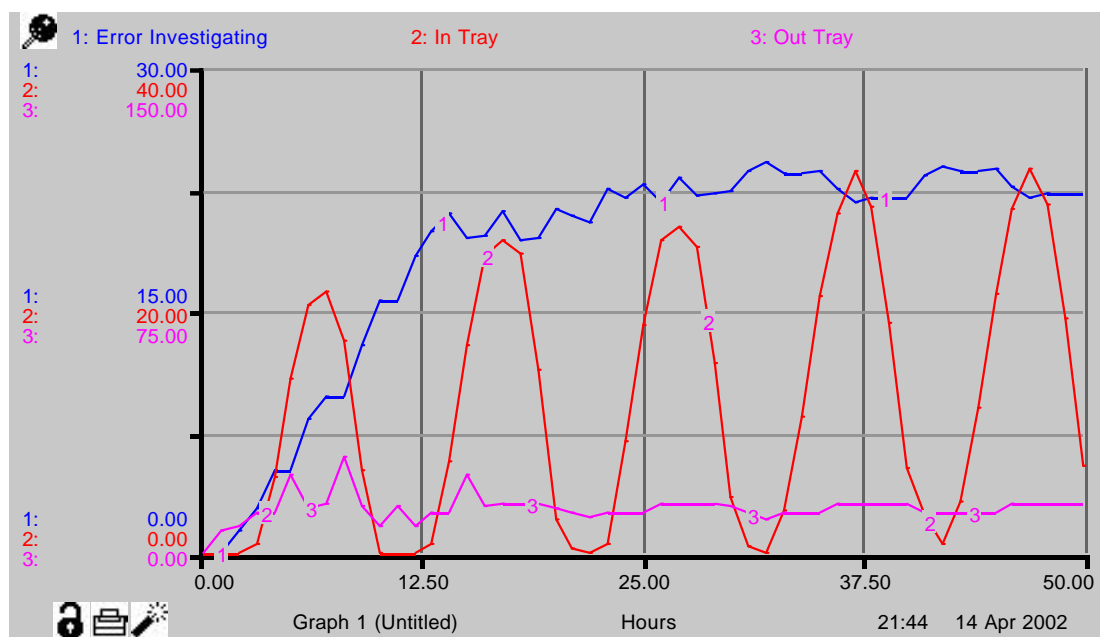
The sampling generated a substantial sample out of which hourly averages (approximated per excess to the whole ticket) of ticket numbers are reported in the following table with their total per day and averages per hour slot and for the whole week.

Hours	Day 1	Day 2	Day 3	Day 4	Day 5	average by hour
1	10	8	5	3	6	6.4
2	12	7	6	9	5	7.8
3	15	13	12	12	11	12.6
4	21	18	17	16	15	17.4
5	25	17	21	18	19	20
6	13	21	19	24	20	19.4
7	9	16	16	22	17	16
8	5	13	11	13	11	10.6
9	0	5	4	7	3	3.8
10	0	1	2	3	0	1.2
Tot	110	119	113	127	107	
week average			115.2			

Using the above values, the model has been run to observe the dynamics of the In-Tray stock and on the number of errors. In the actual Rick Management project, this last figure together with overtime data needed to clear backlog in case of pulses has then been taken as input for other analysis performed with tools and methods outside of the System Dynamics domain.

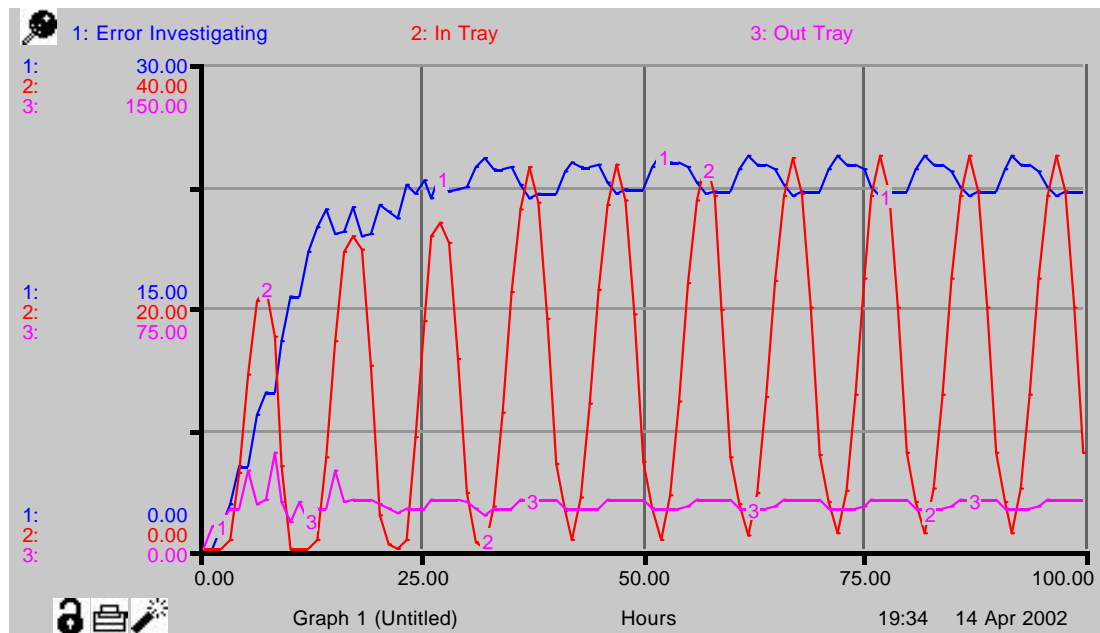
The simulation.

The run for 50 hours (equal to a working week of 5 working days and 10 working hours per day) originated the following behaviour, where at the end of the 50th hour there is a remaining stock of 7.2³ tickets.



By repeating the simulation for a time of 100 hours (equal to two working weeks of 5 working days and 10 working hours per day), the model originated the below behaviour:

³ Since the model used statistical values, the project team decided to keep figures as they were, without approximating them to the whole ticket.



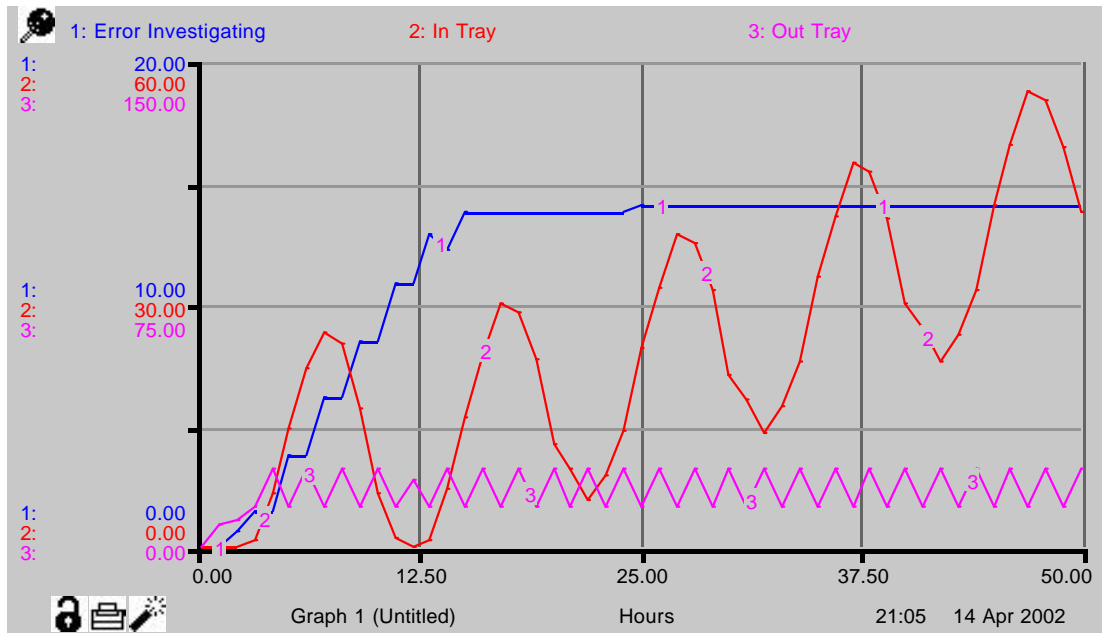
It is possible to observe that the In-Tray stock remaining is equal to 7.2 at the end of the first week (end of 50th hour) and 7.28 at the end of the second week cycle (end of 100th hour).

The fact that the remaining stock was remaining constant at 7.28 tickets at the end of the weekly cycle and taking in account all the approximations and possible sampling errors, has been assumed as a proof of validity of the model since it was reproducing a situation of equilibrium observed during the sampling in which the normal volumes were handled within the 10 working hours / day by the allocated resources. The maximum stock value at In-Tray level of 32.37 is in the range of the maximum measured values.

Behavioural observations

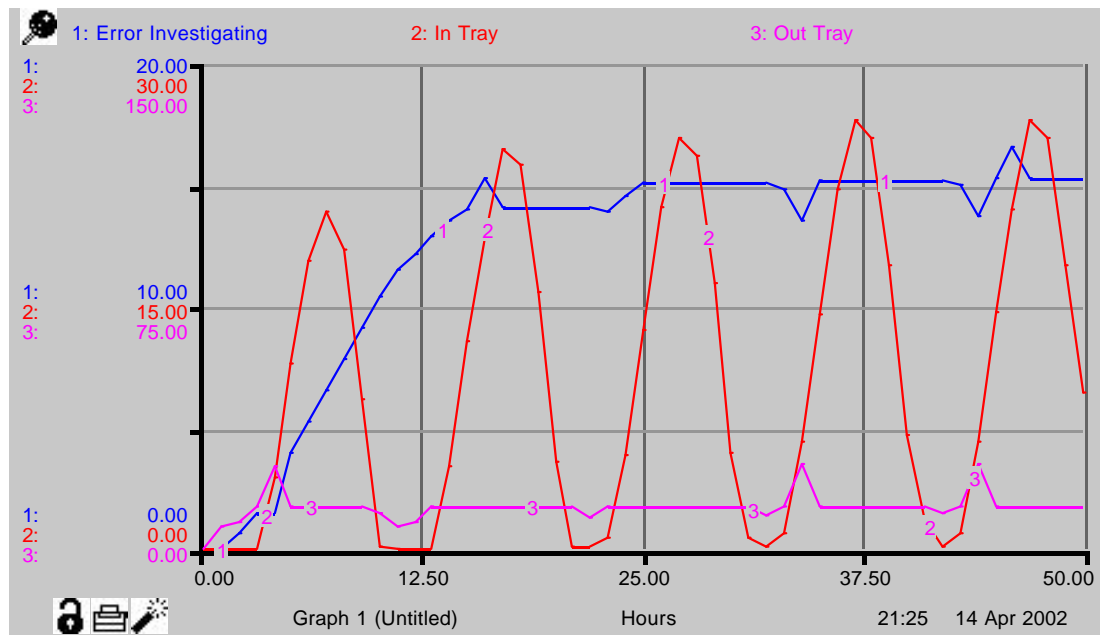
In the reality reproduced by the model there is a change of behaviour at changing volumes of incoming tickets. As the ticket volumes go up, the person performing the confirmation activity speeds up the work. He works at full capacity with an average of 8 hours per day plus an average of 2 extra hours of overtime. The direct cost per ticket processed is kept to the minimum but a more deep analysis should note that this situation generate other costs in the form of time take to the resource in charge of settlement processing to investigate the errors and the cost of reprocessed tickets. To this consideration must also be given with regards to the consequences deriving from the collateral, edging and the potential fines (even if rather infrequent) from counterparts.

The below diagram shows the dynamics of the system in presence of an enforced behaviour in which the processing time keeps being optimal at 5.08 minutes per ticket corresponding to an error rate of 9.96%.



The resulting dynamics shows a growing accumulation at In-Tray level as a clear evidence that one resource working at the nominal time of 50 hours per week is not sufficient to clear the incoming ticket volume while keeping the optimal work quality. It must be said that with the previous simulation reflecting the actual situation the maximum number of tickets under investigation due to errors is 24.13 / hour against the 14.12 wrong tickets per hour of the optimal processing time scenario.

This value is anyway deceiving since is it a natural consequence of the fact that by forcing the processing behaviour, the processing capacity has been transformed to a constant of 11.81 tickets per hour (60 mins / 5.06 mins per ticket). However, by increasing number of people allocated to confirmation processing while keeping the processing time at optimal value it is possible to observe that it is possible to reach a new state of operational equilibrium while keeping an optimal quality of processing.



The above diagram reports such dynamics and it has been calculated by a simulation with a fixed optimal processing time and number of errors and by allocating 1.1 resource to confirmation processing. 1.1 resource can be practically obtained by having 1 person working 10 regular hours plus 1 hour from another resource. Alternatively, it may take a different task allocation configuration dependent from consideration at resource cost and availability level that are outside of this proposed presentation.

It is important to note that in this case the maximum number of wrong tickets under investigation never goes over the 16.61 threshold as consequence of the increased quality of processing.

Other conclusions

Apart from proving that System Dynamics can provide a unique tool for modelling intangibles for Operational Risk Management purposes, the above reasoning also proves that in circumstances such as BPR and process optimisation adopting an approach typical of spreadsheet reasoning may be counterproductive since it fails to capture important factors such as the variability of human behaviour at changing circumstances and the second level consequences so originating.

Apart from its utilization within the Operational Risk Management context, this model will also become the core of a proposal to review the operational structure of the back office processing from a systems perspective encompassing not only the process side but also the side effects of HR policies. In this latter case the model will be used also for personnel training purposes to share awareness about the actual and secondary effects of behaviours and policies that may appear correct and working properly under a common analysis.

Appendix 1 – Model equations

Confirmations

$$\text{In_Tray}(t) = \text{In_Tray}(t - dt) + (\text{Collecting_Tickets} + \text{Resubmitting_Wrong_Tickets} - \text{Processing}) * dt$$

$$\text{INIT In_Tray} = 0$$

INFLOWS:

Collecting_Tickets (Not in a sector)

Resubmitting_Wrong_Tickets (Not in a sector)

OUTFLOWS:

$$\text{Processing} = (1/(\text{Processing_Time}/60))*\text{People}$$

$$\text{Out_Tray}(t) = \text{Out_Tray}(t - dt) + (\text{Processing} - \text{Settlement_processing} - \text{Errors_at_Settlement_stage}) * dt$$

$$\text{INIT Out_Tray} = 0$$

INFLOWS:

$$\text{Processing} = (1/(\text{Processing_Time}/60))*\text{People}$$

OUTFLOWS:

Settlement_processing (Not in a sector)

Errors_at_Settlement_stage (Not in a sector)

$$\text{People} = 1$$

$$\text{Error_Rate} = \text{GRAPH}(\text{Processing_Time})$$

(3.97, 9.96), (4.05, 10.1), (4.07, 10.4), (4.12, 10.9), (4.23, 11.7), (4.25, 12.8), (4.60, 14.1), (4.63, 15.4), (4.80, 16.9), (4.85, 18.1), (4.97, 18.9), (5.03, 19.4), (5.08, 19.6)

$$\text{Processing_Time} = \text{GRAPH}(\text{In_Tray})$$

(0.00, 5.05), (1.00, 5.05), (2.00, 5.05), (3.00, 5.05), (4.00, 5.05), (5.00, 5.05), (6.00, 5.05), (7.00, 5.05), (8.00, 5.05), (9.00, 5.05), (10.0, 5.03), (11.0, 4.93), (12.0, 4.80), (13.0, 4.67), (14.0, 4.54), (15.0, 4.39), (16.0, 4.29), (17.0, 4.20), (18.0, 4.13), (19.0, 4.08), (20.0, 4.05), (21.0, 4.05), (22.0, 4.05)

Not in a sector

$$\text{Error_Investigating}(t) = \text{Error_Investigating}(t - dt) + (\text{Errors_at_Settlement_stage} - \text{Resubmitting_Wrong_Tickets}) * dt$$

$$\text{INIT Error_Investigating} = 0$$

$$\text{TRANSIT TIME} = 12$$

$$\text{INFLOW LIMIT} = \text{INF}$$

$$\text{CAPACITY} = \text{INF}$$

INFLOWS:

$$\text{Errors_at_Settlement_stage} = \text{Out_Tray} * (\text{Error_Rate}/100)$$

OUTFLOWS:

$$\text{Resubmitting_Wrong_Tickets} = \text{CONVEYOR OUTFLOW}$$

$$\text{Collecting_Tickets} = \text{Trade_Volumes}$$

INFLOW TO: In_Tray (IN SECTOR: Confirmations)

Settlement_processing = Out_Tray*(1-(Error_Rate/100))

OUTFLOW FROM: Out_Tray (IN SECTOR: Confirmations)

Trade_Volumes = GRAPH(TIME)

(0.00, 6.40), (1.00, 7.80), (2.00, 12.6), (3.00, 17.4), (4.00, 20.0), (5.00, 19.4), (6.00, 16.0), (7.00, 10.6), (8.00, 3.80), (9.00, 1.20), (10.0, 6.40), (11.0, 7.80), (12.0, 12.6), (13.0, 17.4), (14.0, 20.0), (15.0, 19.4), (16.0, 16.0), (17.0, 10.6), (18.0, 3.80), (19.0, 1.20), (20.0, 6.40), (21.0, 7.80), (22.0, 12.6), (23.0, 17.4), (24.0, 20.0), (25.0, 19.4), (26.0, 16.0), (27.0, 10.6), (28.0, 3.80), (29.0, 1.20), (30.0, 6.40), (31.0, 7.80), (32.0, 12.6), (33.0, 17.4), (34.0, 20.0), (35.0, 19.4), (36.0, 16.0), (37.0, 10.6), (38.0, 3.80), (39.0, 1.20), (40.0, 6.40), (41.0, 7.80), (42.0, 12.6), (43.0, 17.4), (44.0, 20.0), (45.0, 19.4), (46.0, 16.0), (47.0, 10.6), (48.0, 3.80), (49.0, 1.20), (50.0, 0.00)