Chapter 4: Design for Process

Contents

Introduction

This chapter explores the aspects of business simulation design that ensure that learning is delivered during use. It covers a Systems Dynamics model that I have developed and use, design for tutoring, design for cognitive processing and design for manner of use.

Systems Dynamics Process Model

Business Simulations involves a feedback process (figure 4.01) where the learners make decisions that are processed by the simulation model producing results. Results that are then fed back to the learners to compare with their desired results. Based on the difference between the actual and desired results and the changing situation, learners make more decisions that are entered into the simulation model. Typically, this process is repeated six or more times.

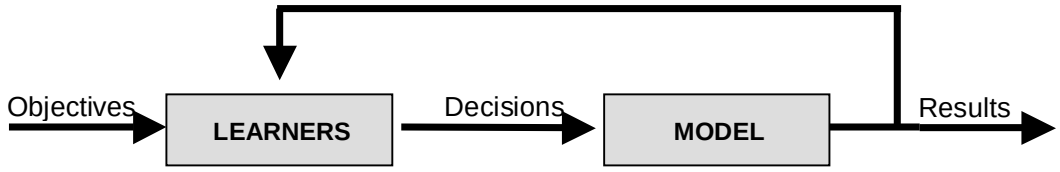


Figure 4.01: Business Simulation – basic feedback process

This process is equivalent to the Forrester's Industrial Dynamics model (1961) (Figure 4.02a) and Forrester's model was developed from the servomechanism feedback process. (Figure 4.02b).

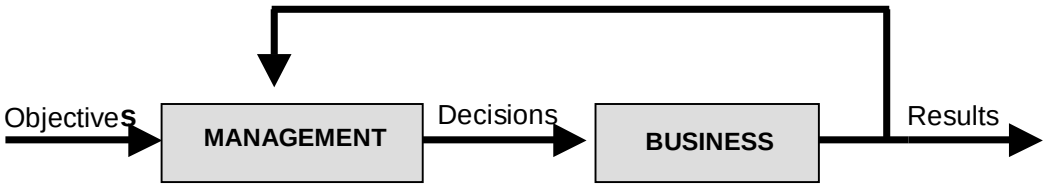


Figure 4.02a Forrester's Industrial Dynamics model

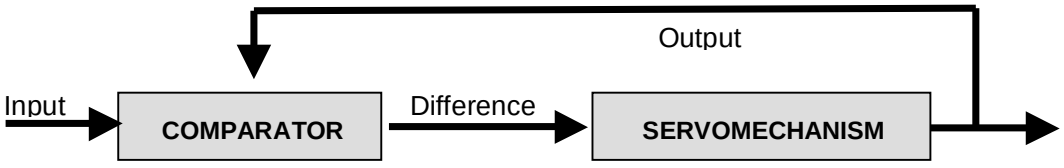
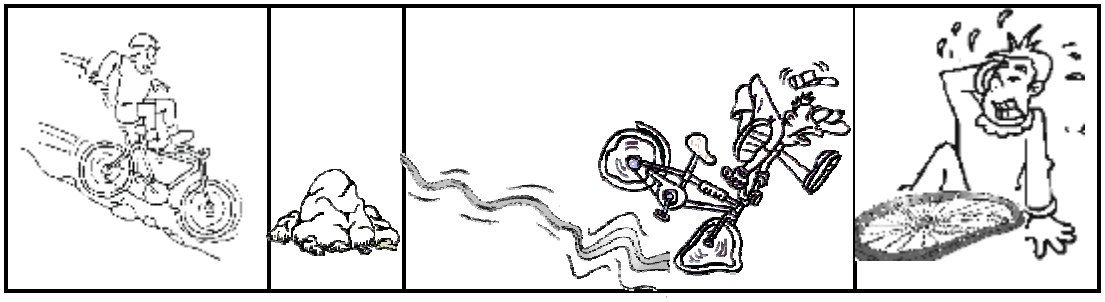


Figure 4.02b: The basic Servomechanism process

The servomechanism designer has the problem of maximising the accuracy with which the servomechanism matches output with input and the speed that it can respond to changes in the input position. Similarly, a business simulation has to match learning objectives with learning outcomes in the shortest possible time and, like a servomechanism, a business simulation is a dynamic system where inappropriate or badly timed feedback can cause catastrophic system failure.



Cartoon 4.01: Designing a business simulation as simple as riding a bike

Inappropriate corrective feedback can be illustrated by how a novice bicycle rider responds to a bump that causes the bike to wobble. He or she corrects the wobble, but because the cyclist is inexperienced the response is delayed and the wobble increases until the rider falls off. In a similar way, not considering the system dynamics of the learning process can cause a catastrophe as participants do not learn and become disaffected.

The servomechanism designer analyses the feedback system in terms real and imaginary dimensions and the frequency response and loop gain of the system. The *real* dimension is concerned with the way the servomechanism matches output to input and thus parallels the way the business simulation matches cognitive development with learning objectives. The way the servomechanism behaves in the *imaginary* dimension provides insights into its stability and, for business simulations it is paralleled with an *affective* dimension that provides insights into the learners *emotional* behaviour and how they are *engaged*. For servomechanisms the speed and accuracy of response is decided by the *frequency response* and *loop gain* of the system and for business simulations, these are paralleled by *learner maturity* and *workload*.

Thus, for business simulations the servomechanism's real and imaginary dimensions map to cognition and affection and the servomechanism's loop gain maps to workload. This equivalence provides insights and has implications in terms of the speed of learning, participant behaviour and cognitive load. To summarise: for business simulations there are three interacting dynamics - cognition, affection and workload.

The Cognitive Dynamic

Just as the purpose of the servomechanism designer is to maximise the speed and accuracy of the response to changes in the input, the purpose of a business simulation is to meet learning objectives in the shortest possible time (effective and efficient learning).

Unlike the conventional learning where expertise is assumed to increase in an S-curve (Dewey, 2007) and this is similar to the servomechanism's response to a step change in input (Coyle, 1977). For a business simulation this is paralleled by a change in required expertise (learning objectives) that is progressively reduced as the business simulation progresses. However, for business simulations learning the S-curve is distorted as, initially, there is slight confusion (Figure 4.03). But, then, learning follows the conventional S-curve. Except, to make most efficient use of the learners' time, the business simulation should end before learning plateaus. (This early ending allows for learning to be consolidated during the business simulation review and with post-simulation reflection.)

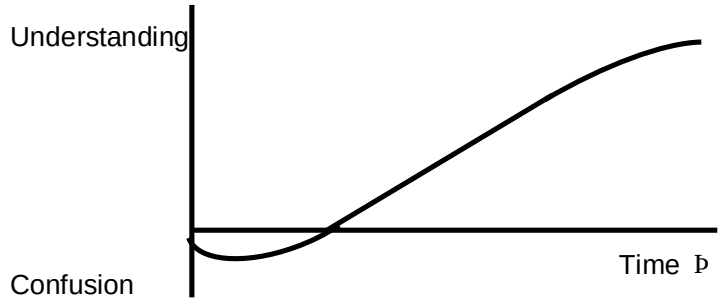


Figure 4.03: The cognitive (learning) dynamic

The cognitive dynamic is concerned with *effective learning* (reaching the desired learning goals) and *effective learning* (reaching these goals in the shortest possible times).

The Affective Dynamic

Besides the cognitive (learning) dynamic, there is an affective (feelings) dynamic (paralleling the servomechanism's *imaginary dimension*) (Figure 4.04) that also has to be managed.

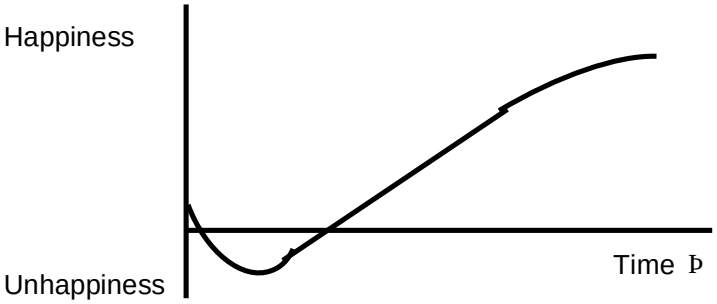


Figure 4.04: The affective (feelings) dynamic

Typically, participants in a business simulation start enthused, feeling that their business acumen will mean that they will find it easy to make good decisions. But then they find the business simulation is harder than expected and their enthusiasm wanes and they may become discouraged. However, as they learn (and perceive business success) their enthusiasm increases.

Affection is influenced by the maturity of learners (their ability to handle stress, success and failure), workload (too high or too low), the relevance of the learning and the structure of their team (mix of knowledge and skills and individual personalities).

The *affective dynamic* takes into account the *people* aspect of the learning group and how the design addresses this during the business simulation. It addresses the extent to which the business simulation is engaging and motivating.

The Workload Dynamic

The final dynamic is cognitive workload. Figure 4.05 shows how cognitive load changes during the business simulation. (This dynamic parallels the servomechanism's frequency response and loop gain.)

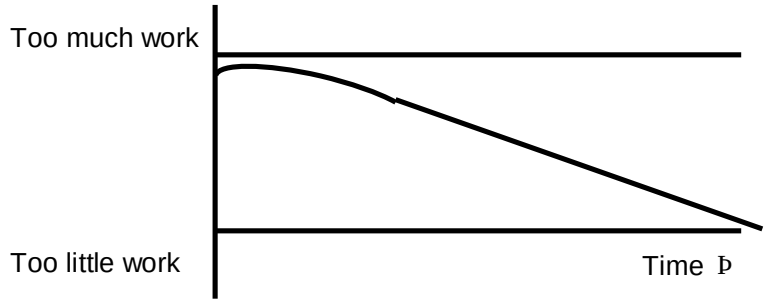


Figure 4.05: The (cognitive) workload dynamic

Typically, as with any new job, learners have to learn about the business and, if appropriate, about their fellow team members and the competition. This means that initially workload is high. However, as they learn workload falls and, as for the real world, a business simulation's workload should not be too high or too low (Figure 4.05).

The Dynamics – problems

This section describes and discusses the problems in terms of cognition (confusion), affection (disaffection) and workload (role overload). These problems that are regularly observed and described in the experiential learning/simulation literature (Cryer 1988a, Hall 1977, Jones 1989, Lundy 1984).

Cognitive Dynamic Problems

With the cognitive dynamic if the business simulation is not linked to participant capabilities (in terms of prior learning and experience) or too much or too little time is allowed then cognitive development will be inappropriately complex for the time available and participants will become progressively more confused (Figure 4.06 – too complex or too little time line).

The opposite problem is where the business simulation is too simple or too much time is allowed for it and this results in the learners rapidly reaching competence and then making inefficient use of their time (Figure 4.06 – too simple of too much time line).

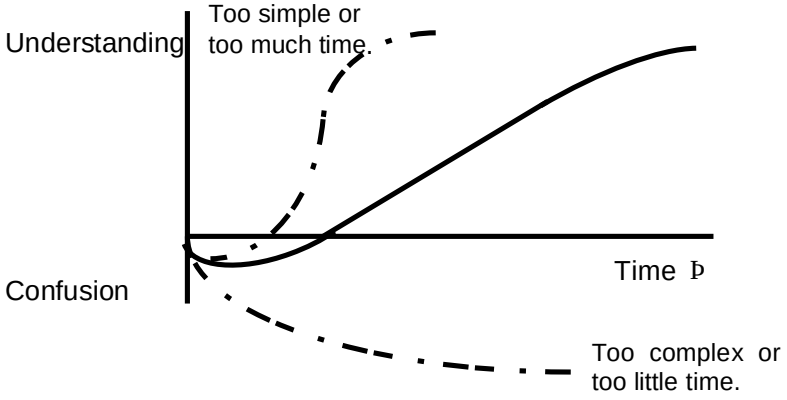


Figure 4.06: Cognitive Dynamic problems

In my experience it is more likely that the business simulation is too complex or too little time is allowed for the activity.

I have found it usual for clients to *overstate* the capabilities of their learners (Hall, 1996) and this results in the design or choice of a business simulation that, relative to the

learners; knowledge and experience, is too complex. Although a business simulation that is too simple creates the same problems, the problem of simplicity can be overcome during the run as the trainer manages the process (see the section on Managed Response later).

Providing too little time for the business simulation is the outcome of the pressure to have short courses. Unfortunately there is a very strong empirical correlation between business simulation complexity and required duration (Hall & Cox, 1994). If duration is shortened too much, learning does not occur as participants never climb the learning curve.

Affective Dynamic Problems

Just as design for the cognitive dynamic has to take into account prior learning, the design for the affective dynamic must take into account maturity, the ability of the learners to handle ambiguity, uncertainty and stress and how the dynamic changes over time. This leads undesirable behaviours – manic where learners over react to success and disaffection where learners overreact to failure (Figure 4.07).

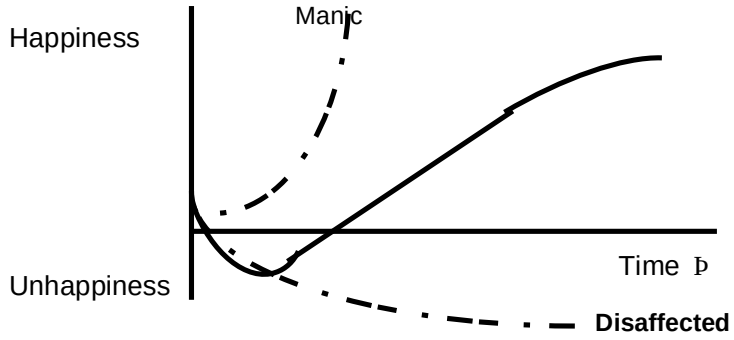


Figure 4.07: Affective Dynamic problems

Workload Dynamic Problems

The final dynamic is (cognitive) workload (Figure 4.08). Even if the business simulation is suitable in terms of cognitive and emotional challenge, an unsuitable workload causes problems. If the cognitive workload is too high then learners will not be able to make thoughtful decisions and this *role overload* (French and Caplan, 1972) will cause disaffection. Equally, if the cognitive workload is too low, participants will not be challenge and become disaffected as they perceive that they are wasting their time.

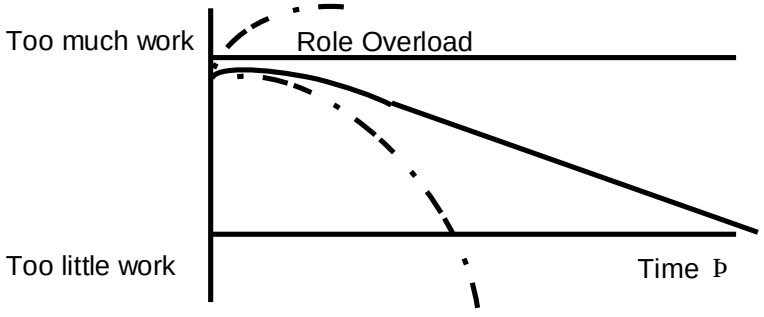


Figure 4.08: Workload problems

Interactions between the Dynamics

Although shown separately, these dynamics interact with one another and influence the effectiveness and efficiency of learning.

If the time provided to make the initial decision is too short, this will mean that there is cognitive overload (role overload) and this will both add to the confusion (cognitive dynamic) and cause disaffection (affective dynamic). Equally, if adult learners feel that they are not learning (cognitive dynamic), they will become disaffected (affective dynamic) and see the activity as a waste of time (workload dynamic). If workload falls too far then adult learners will feel that their time is being wasted and become disaffected (affection dynamic). Further, this means that learning efficiency is lessened (cognitive dynamic).

Another way of looking at the interactions between the dynamics is in the context of *flow* (Csikszentmihalyi, 2002). Csikszentmihalyi discusses this in terms of *optimal experience* in *a goal-directed, rule-bound action system* – balancing challenge and abilities (Figure 4.09).

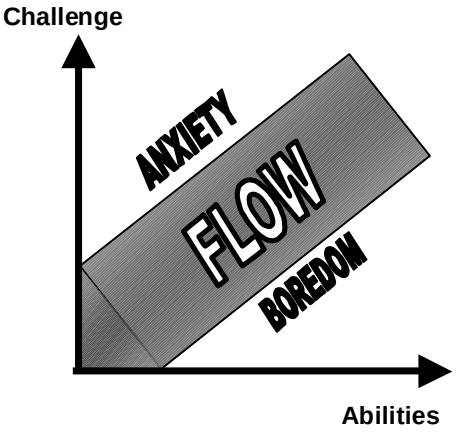


Figure 4.09: Csikszentmihalyi's Flow

Figure 4.10 suggests two ways that experience could *flow* over time. Line A runs up the centre of the area of flow and is the line of maximum *enjoyable experience*. Csikszentmihaly depicts this as *"an activity that produces such experiences is so gratifying that people are willing to do it for its own sake, with little concern for what they get out of it, even when it is difficult or dangerous"*. But it is likely that *optimal enjoyment* is at the expense of learning (Vroom, 1978; Yerkes and Dodson, 1908). Arguably, for learning, the optimal flow line is B. Here, the experience borders on anxiety and as such ensures challenge and, is likely to force learners to think deeply about the experience.

But, the actual pattern is not likely to be like pattern B (Figure 4.10). Rather it is like to pattern in figure 4.11. Here learners initially expect the business simulation to be an enjoyable experience because they feel that their existing business expertise will ensure they do well.

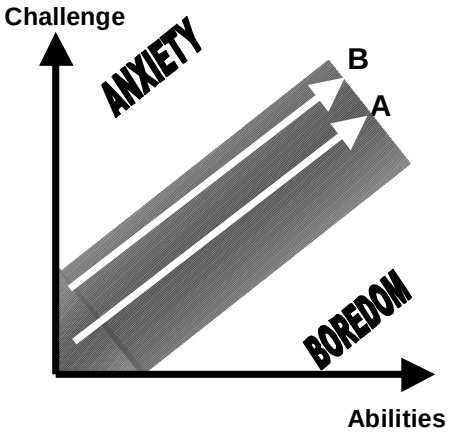


Figure 4.10: Flow Patterns

they do well.

They are likely to start at *flow* level (C_0). However, they soon find that the business simulation is harder than envisaged and become anxious (C_1).

Then, as learning takes place, anxiety reduces and affection increases (C_2). But, then, if challenge is not increased the movement is to boredom (C_3). Consequentially, at C_2, new challenges should be introduced and this pattern repeated (to C_4).

Figure 4.11 suggests that the ideal situation is where the complexity and challenge of the business simulation increases as time passes and as participants' learn. If this is not done, there is a risk that the participants will become bored.

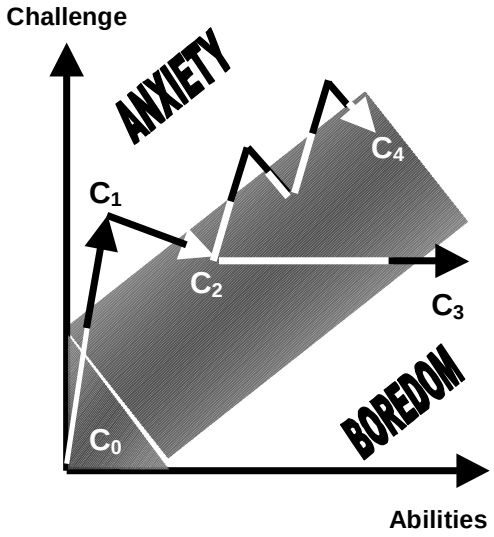


Figure 4.11: Actual Flow Pattern

How does one design the **C_0, C_1, C_2, C_4** line? As the greatest *anxiety* is likely to occur at the start of the business simulation (C_1), this must be taken into account in terms of initial complexity (number and ambiguity of decisions), difficulty (economic situation) and preparation time. Usually, the initial complexity is overcome by period 2 or period 3 (C_2) and at this point it is possible to introduce in new reports, decisions and tasks (*Viewpoint, Issue* and *Task Progressions*). Additionally, throughout the business simulation it is judicious to use *Economic Progression* to increase the challenge.

Figure 4.12 shows a diagonal cross section with the vertical axis enjoyment and the horizontal axis ranging from boredom, through *flow* to anxiety. To the left, the learners; abilities are not being challenged. To the right, anxiety is increasing.

The business simulation designer is faced with the need for effective and efficient learning and this means that he or she must ensure engagement (but not *manic*, mindless enjoyment). This is shown in figure 4.12 as the movement from C_2 to C_4. In figure 4.12 this is shown as the Ideal – a band that provides sensible engagement and reasonable challenge. Thus this ideal ranges from minor anxiety zone to some enjoyment (flow).

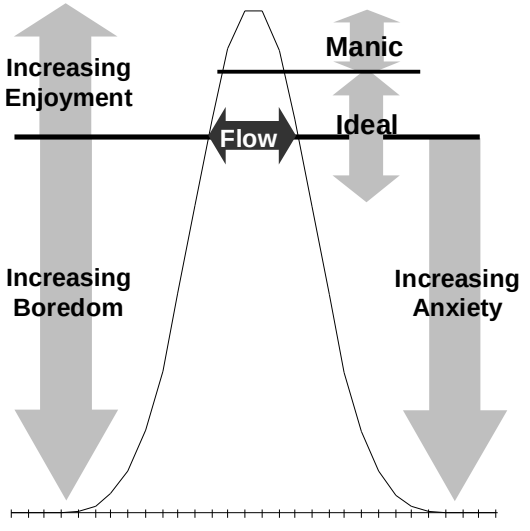


Figure 4.12: Positioning the Experience

Experience suggests that the size of the *ideal zone* depends on the *maturity* of the learners. Thus emotionally mature learners (business people with significant experience) can better handle anxiety and are less likely to become manic! In contrast immature (younger, less experienced) learners are less able to handle anxiety and are more excitable!

Design Practicalities

There are two means of overcoming the problems (Hall & Cox, 1993) – natural response (built into the business simulation design) and managed response (where the tutor takes appropriate actions as the business simulation runs).

Natural Response Design

The dynamic design of a business simulation involves taking into account the dynamics. This is designing the *natural pre-planned response* (Hall & Cox, 1993) of the business simulation as it progresses from period-to-period or stage-to-stage in terms of:

- Static Response Calibration
- Dynamic Response
- Economic Response
- Result Evolution
- Decision Evolution

The Natural Response design must not only take into account cognition but also affection (feelings) and workload.

Static Response Calibration

This involves deciding the parameters that drive the simulation model to ensure that it is appropriately realistic to ensure appropriate learning. Amongst other things it involves deciding the relationship between fixed and variable costs, the relationship between fixed assets and working capital, interest rates, price levels and sensitivities, market sizes and potential etc. When designing the DISTRAIN the client required that the calibration reflected that of their industry. Although this was possible, there was a major problem as In the real world it was easy to lose money but difficult to be profitable – a situation that would lead to disaffection and disengagement. In the end, at the start of the business simulation learners took over a business that was nearly loss making. But over time the calibration ensured that it was possible to be as profitable as the best companies in the industry. Static Response Calibration involves balancing reality with engagement taking into account that learners will not make optimum decisions and so the actual level of success will be less than the possible success. For DISTRAIN, if learners had made *perfect* decisions they would have been far more successful than the best real world companies but in use the learners were never as successful.

An example of disaffection caused by inappropriate static response calibration is one of the first business simulations that I used (rather than designed). This had the unfortunate feature that it was virtually impossibly to get past the second period without running out of cash and becoming bankrupt. This is real in the context of company start-ups but had a disastrous affect on the learners who (after being made bankrupt several times) decided that the business simulation was a waste of time.

Dynamic Response

This is a second aspect of Natural Responses, but unlike Static Response Calibration it is concerned with the behaviour of the business simulation over time. For example my CISCO business simulation (named after the CISCO kid and not the US company) is a complex, realistic simulation of a company that bids for business and then delivers the contracts won. Unfortunately, like the real world learners tended to swing between having too much business and too little business. The only way we found to overcome this problem was to adjust the contracts available as the business simulation progressed. This involved generating new contracts with different resource needs, sizes, contract terms etc. based on the current situation. This involved one trainer full time and increased

the cost of using the business simulation significantly and, often, the adjustments were not successful!

The dynamic response design is concerned with the stability of the business simulation and how delayed responses impact this and can lead to untenable positions. For example, the first version of Product Launch, increasing price had an immediate impact but reducing price had a delayed impact as it would take customers time to become aware of price cuts and increase the amount they purchased. Although real, this made it impossible for learners to understand the impact of their pricing decisions.

Initially, with DISTRAIN I built in a model that accumulated the effect of inventory shortages. The rational behind this was that in this industry the perception of inventory availability was a key aspect of the market. Unfortunately this led to a situation where it was impossible to recover from poor customer service and so this effect had to be removed from the model.

When designing the business simulation take care with delayed and accumulated responses.

Economic Response
This defines the way the business simulation's business and economic environment changes and evolves over time. It incorporates the economic progression/evolution, the business progression/evolution and the issue progressions (Chapter 3). Commonly, I start the business simulation in a liquid situation and over time erode this liquidity as the learners grow the business. Because the initial situation is liquid, learners do not have to be concerned with cash flow and this reduces the cognitive load. However, as the business simulation progresses and as the cognitive load decreases, learners are able to handle the additional cognitive load caused by having to handle liquidity (or solvency) problems.

Results Evolution
This allows the progressive introduction of different viewpoints and issues and hence stimulate thought and discussion about different business issues. The data behind the reports must be built into the business simulation. But as, in general, this is required as part of the design, it is unlikely to lengthen design time and increase design cost. Figure 4.13 shows how the reports evolve for the Progressive Version of the Product Launch simulation.

Product Launch – Progressive Version	
Period	Report
1	Single, basic report showing outcomes for the period
2	Basic report plus comments to stimulate thought
3	As for period 2 plus a report showing decision and result trends
4	As for period 3
5	As for period 4 plus report showing trends in marketing issues
6	As for period 5 plus profitability report and sales graph
7	As for period 6 plus sales forecasting report and income & profit graph

Figure 4.13: Result Timing – Product Launch Simulation

An important aspect of result evolution is ensuring the relevance of the reports and how they relate to the learners' prior learning. This means that it is attractive to have several versions of the simulation each producing a different set of reports. For example, Product

Launch has a simpler version, where the reports do not evolve but remain as a single, basic report showing outcomes for the period.

Decision Evolution
This allows the progressive introduction of different issues and tasks. The models linking the decisions and results must be built and before a decision is introduced the business simulation may have to make the decision *intelligently* on behalf of the participants. This is illustrated in the example (Figure 4.14) where before the staff number decision is made (Period 2) the simulation model automatically calculates the *best* number of staff to employ. As the decisions are introduced, it is necessary to introduce reports indicating their outcomes.

DISTRAIN – Decision Evolution	
Period	Decisions
1	Percent Markup, Inventory Purchases, Marketing (Sales Support)
2	As for period 1 plus Staff Numbers
3	As for period 2 plus Training Days
4	As for period 3 plus Number of Products and Receivable Days
5	As for period 4 Electronic Linkage, Demo Equipment, Demo Room and Small Project Initiative

Figure 4.14: Decision Timing – DISTRAIN Simulation

Introducing new decisions also impacts affection as is illustrated by this statement from the DISTRAIN tutors *"the continuous introduction of new ideas kept everyone interested".*

Impacts on the dynamics
Combined Economic Response, Report and Decision Evolution ensures that workload is maintained (shaded area Figure 4.15a) and this allows additional learning or shortens the business simulation (shaded area Figure 4.15b)

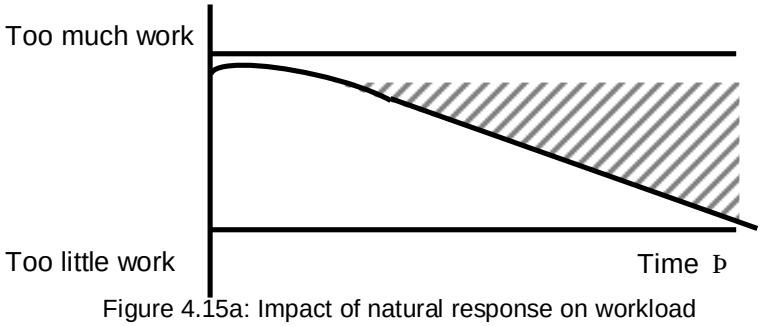


Figure 4.15a: Impact of natural response on workload

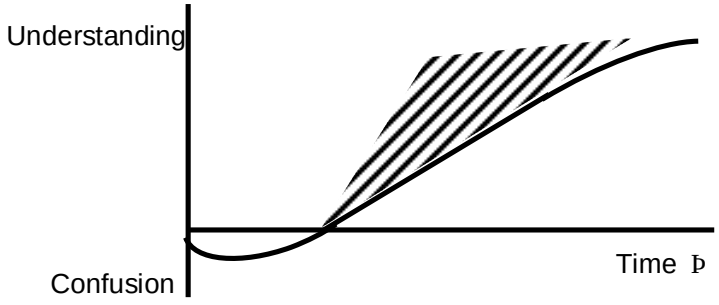


Figure 4.15b: Impact of natural response on cognition

Besides managing the cognitive and workload dynamic, there is a need to manage the affective dynamic in terms of the *style* of the feedback and simulation difficulty (Figure 4.16)

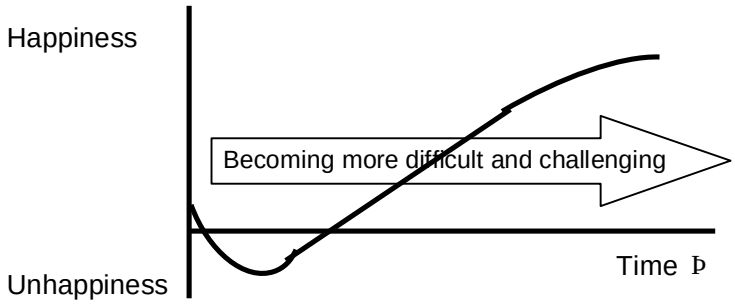


Figure 4.15c: Impact of natural response on affection

As the business simulation progresses, the initial feedback should be positive (concentrating on business strengths) but later, it can become negative (extending to business weaknesses). Initially the business simulation might make comments about good levels of profitability, sales growth, etc but not mention losses and weaknesses. Later the business simulation would identify areas of weakness (such as a poor mix of business, losses on individual product sales, etc.) and, perhaps, raise profitability expectations. Figure 4.16, illustrates this process.

Periods 1 and 2	Periods 3 and 4	Periods 5 and 6
Major Strengths	Major Strengths	Major Strengths
Middling Strengths	Middling Strengths	Major Weaknesses
Minor Strengths	Middling Weaknesses	Middling Weaknesses
Minor Weaknesses	Minor Weaknesses	Minor Weaknesses

Figure 4.16: Strength and Weaknesses over course of the simulation

The *ramping* of economic difficulty and the number of results and decisions prevents cognitive overload in the early stages of the simulation.

Managed Response Design

Where a business simulation is used run by a trainer, he or she can coach and challenge learners and answer their questions on a proactive basis (Figure 4.17). (The elements of the Tutor Support System and learning management are discussed later.)

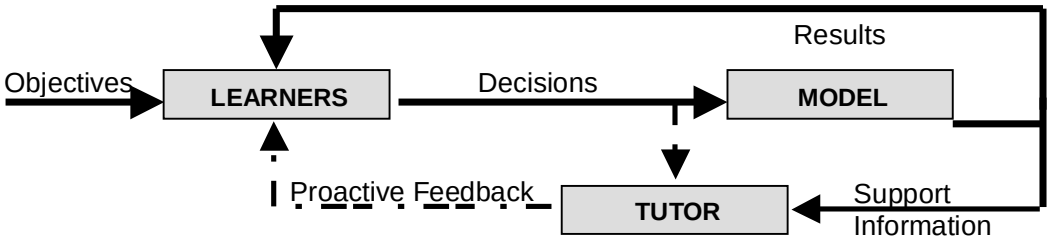
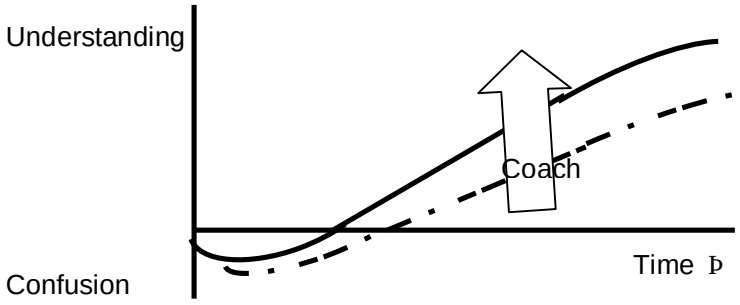


Figure 4.17: Tutor Supported Feedback System.

Providing tutor-mediated feedback allows the cognitive and affective dynamic responses to be *managed* based on the actual knowledge, experience and maturity of the learners. Appropriate *content* feedback can reduce cognitive learning problems and increase learning (figure 4.18a) and how the appropriate *style* of feedback can deal with problems with the affective dynamic (figure 4.18b).



1igure 18a: Tutor Managing Cognition

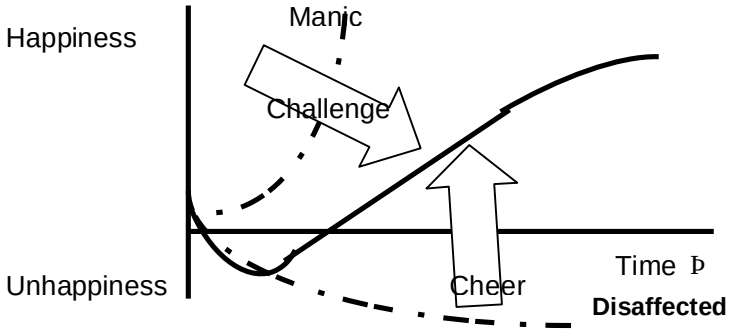
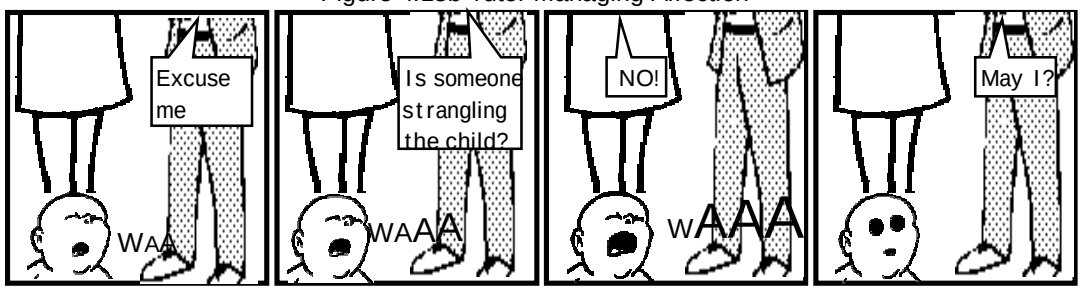


Figure 4.18b Tutor Managing Affection



Cartoon 4.02: Managing Affection

Workload

This can be managed by shortening the time between decision periods, providing additional reports that cause the learners to discuss new aspects of and issues with the business that they are managing or playing the role of *head office* and asking the learners to provide information.

Managing the Learning Process

For the tutor to take appropriate and timely action, the business simulation must provide the information needed to identify problems and manage the learning process (Figure 4.19)

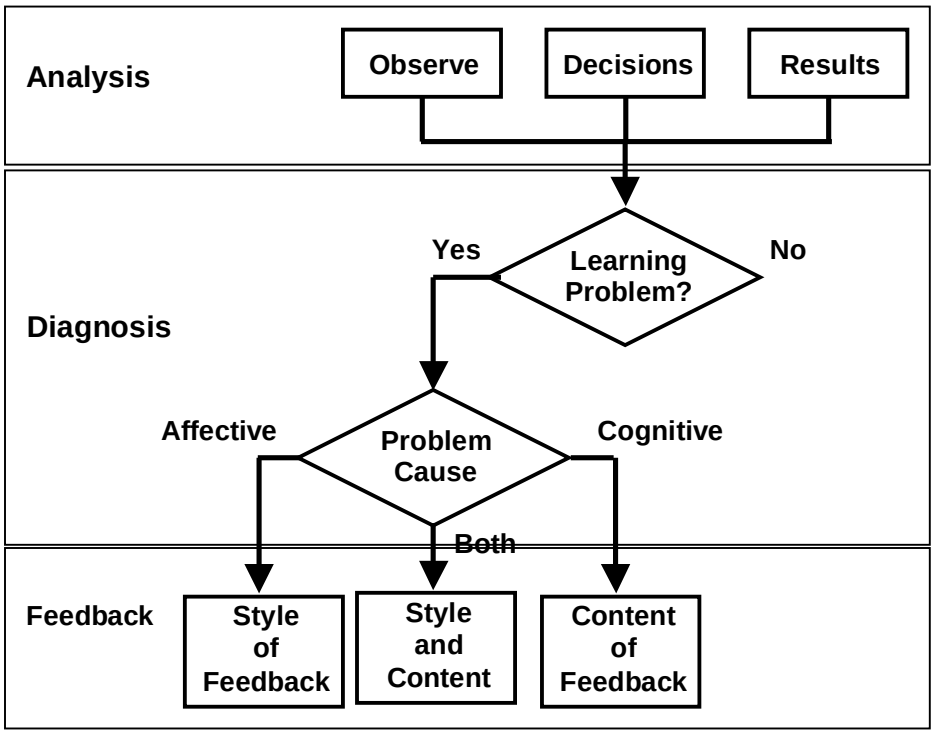


Figure 4.19: Learning Process Management by Tutor

Although at the **analysis** stage the simulation software cannot help with the observation of the team. But it should the decisions and results to identify whether there is a learning problem. The simulation can warn of decisions that are illegal, unusual or sophistic – decisions that may indicate misunderstandings or lack of business knowledge (cognitive problems) or are arbitrary (affective problems).

At the **diagnosis** stage the simulation can process results to identify *strengths* and *weaknesses*.

At the **feedback** stage, the simulation can help provide supporting information that can be provided to the teams as appropriate.

Design for Tutoring

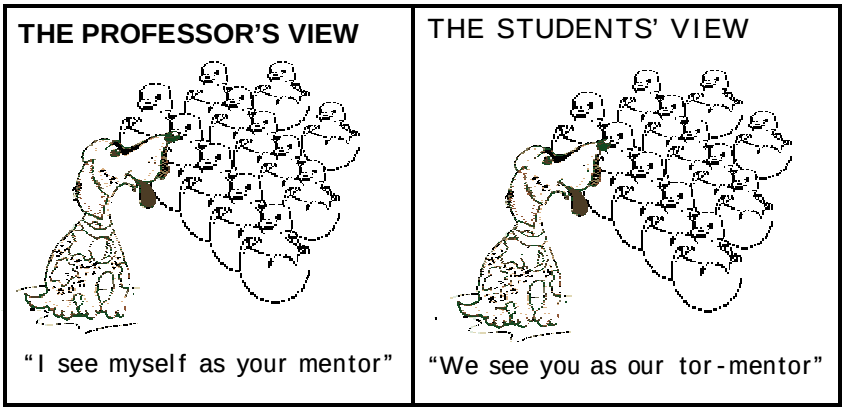
Beyond the design for learning process one needs to design for tutoring and this is based on the tutor's role and tasks and information flows through the simulation. There are three types of task (Hall, 1994a) that are performed as a business simulation runs – administration, facilitation and learning management. This section describes these, the support that should be built into the simulator and information flows between the learners, the business simulation and the tutor.

Administrator

The administration task ensures that the business simulation runs smoothly. And although most of the administration tasks are delegated to the computer there is still some work that must be done by the tutor (Tutor Mediated simulations) or the learners (Direct Use simulations). In the main these are the entry of decisions and the selection, display and printing of non-standard reports.

Facilitator

The facilitation task ensures that all the participants' questions can be answered authoritatively, completely and quickly. It provides a detailed explanation of the accounting and operational calculations performed by the simulation (white box) model.



Cartoon 4.03: The Tutor's Role

Manager of Learning

The learning management task ensures that learning is stimulated proactively and the teams are coached when and as needed. Business simulations are student centred and leaning is *delegated* to them but the responsibility for delivering effective, efficient and consistent learning and so the support must be provided to do this.

The *passive* and *reactive* facilitation task is deliberately separated from the *proactive* learning management task.

Tutor/Participant Support Systems

In order to support these tasks business simulations need a built in Tutoring Support System (for Tutor Mediated simulations) (Hall, 1994b) and a Participant Support System (for Direct Use simulations) (Hall, 1994c). Figure 4.20 shows the elements of these support systems and links them to the tasks.

TASKS	Administration	Facilitation	Learning Management
Help System	✓	✓	
Decision Screen	✓	✓	✓
Reconciliations	✓	✓	
Business Analysis		✓	✓
Comments			✓

Figure 4.20: Tutor Support elements

Help System

This needs to be an *online, context sensitive, hypertext help system* that explains how to use the software, explains the current task and, for Direct Use simulations, defines terms. The help screens displayed depend on the current task and what the simulator user is

doing. Figure 4.21 is to help the tutor running a Tutor Mediated simulation with the Master Menu (underlined word and phrases are links to additional help.)

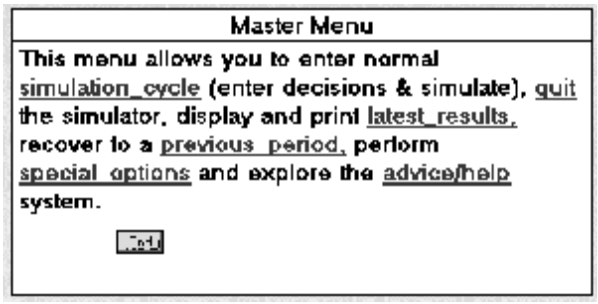


Figure 4.21: Software use help

Decision Screening

Whenever **decisions** are entered into the simulator they should be **screened** at three levels to see if they:

can be processed (legal decisions)
are unusually large or small
are "sophistic"

Illegal Decisions

These are decisions that unreasonable (like zero prices) and cannot be processed. They are commented on and rejected.

Unusual Decisions

These are decisions that are unusually large or small (such as zero advertising or doubling capacity)

Sophistic Decisions

These are decisions that, based on the current business situation and trends, suggest a lack of business acumen and clear thinking (such as pricing below the current variable unit cost or investing heavily in capital equipment when liquidity is low).

Unusual and sophistic decisions are commented on and can be accepted or changed.

Decision screening ensures that *mistakes and misunderstandings are trapped* before simulation. For Tutor Mediated decision, comments are provided to the tutor who then decides how to act on them and whether to discuss them with the learners. For Direct Use simulations, comments are provided directly to participants. Where they are *unusual* or *sophistic,* the learners must decide whether they use them or not.

Figure 4.22 shows decision comments from the Modern Banking simulation commenting on the level of quality and productivity improvement for one group of staff. (The message is derived from an analysis of the number of staff employed and the amount to be spent on improving quality and productivity. Based on these comments the tutor must decide whether or not to question this team on quality and productivity improvement policy.)

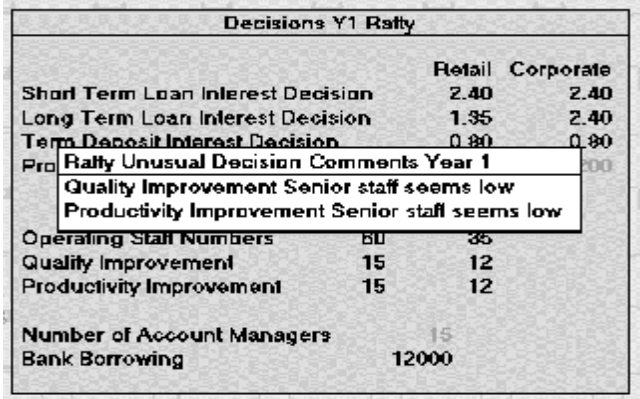
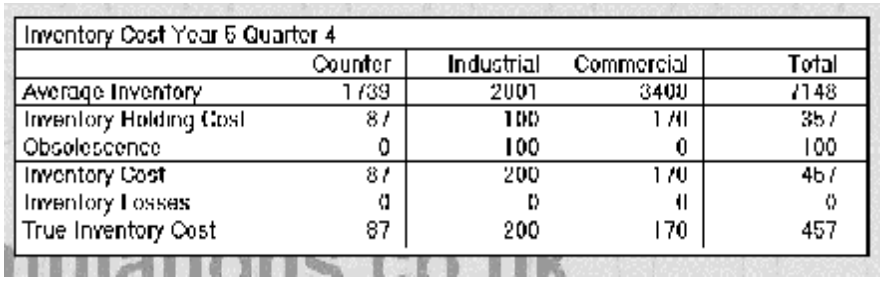


Figure 4.22: Decision Screen comments

Reconciliations

These are a series of reports that show, in detail, how the financial and operational results are calculated. They *allow the tutor to explain and reconcile results* in response to questions asked by the participants**.** Figure 4.23 shows a report from the DISTRAIN simulation showing how the cost of inventory is calculated.



Inventory Cost Year 5 Quarter 4

	Counter	Industrial	Commercial	Total
Average Inventory	1739	2001	3408	7148
Inventory Holding Cost	87	100	170	357
Obsolescence	0	100	0	100
Inventory Cost	87	200	170	457
Inventory Losses	0	0	0	0
True Inventory Cost	87	200	170	457

Figure 4.23: Reconciliation Report

Business Analysis

These are a series of reports that help compare and explain differences between teams (Tutor's Audit) and detail an individual team's performance (Team Commentaries).

Tutor's Audit

This consists of a series of reports that compare teams and so *highlights and records differences between teams* allowing tutor to quickly identify which teams need *coaching* and which teams need *challenging*. (Figure 4.24 shows a report from the DISTRAIN simulation comparing the competing teams' financial performance.)

Business Measures Year 5 Quarter 4				
	NADS	MSWE	Attack	Acme
Net Profit	561	755	545	943
Sales Revenue	11360	11781	10638	10536
Profit Margin %	4.9	6.4	5.1	8.9
Sales Revenue	11360	11781	10638	10536
Total Assets	14538	12712	16046	11157
Asset Turn	3.1	3.7	2.7	3.8
Total Assets	14538	12712	16046	11157
Net Worth	6197	6066	6103	6768
Financial Leverage	2.3	2.1	2.6	1.6
Profit Margin %	4.9	6.4	5.1	8.9
Asset Turn	3.1	3.7	2.7	3.8
Return on Assets	15.4	28.7	13.6	33.8
Financial Leverage	2.3	2.1	2.6	1.6
Return on Net Worth	36.2	49.8	35.7	55.8

Figure 4.24: Tutor's Audit Report

Team Commentaries

These record the progress of individual teams. They consist of several reports that *analyse team performance*. These commentaries can also be used to help individual team coaches & assessors and provide a record that can be used in the post simulation review or as the basis of a formal report. Figure 4.25 analyses the costs associated with incorrect staffing (DISTRAIN simulation).

Staff Losses Year 5 Quarter 4		
	Current	Todate
Overtime Premium	11	112
Idle Staff Cost	4	35
Staff Shortage	0	556
Staff Cost Variance	15	703

Figure 4.25: Team Commentary Report

Comments

Besides the usual quantitative reports, many of my business simulations provide qualitative comments on team's strengths and weaknesses. These replicate the feedback that might be received from staff, customers, suppliers, etc. For Tutor Mediated simulations these comments are provided to the tutor who then decides whether and how they are fed back to the learners. For Direct Use simulations, the comments are provided directly to the learners and so should be deliberately fuzzy to ensure that the teams must discuss and decide the relevance of the comment and decide whether to change their actions. Figure 4.26 shows an example of comments from the DISTRAIN simulation

Middling Weaknesses Year 5 Quarter 4
Accountants feel Inventories seem high for Industrial
The Bank is worried about Solvency

Figure 4.26: Comments

(It is reasonable to say for Figure 4.26 that accountants always feel that inventories are too high although it is less certain that bankers always worry about solvency.)

Information Flows

This section shows the main information flows as the simulation runs for Tutor Mediated and Direct Use simulations.

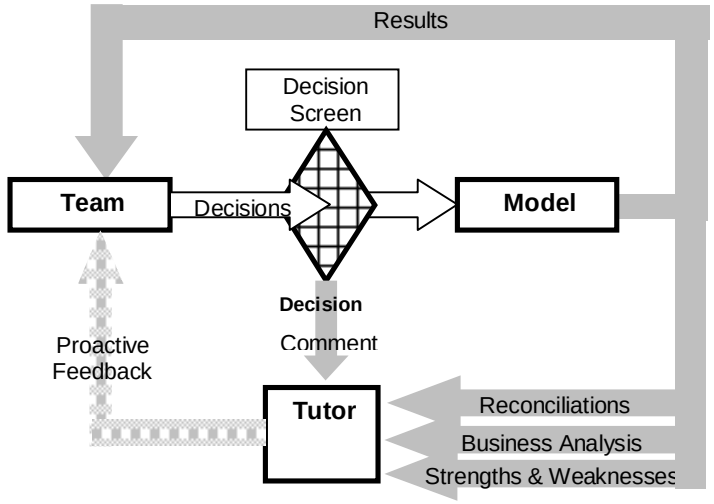


Figure 4.27a: Tutor Mediated Information Flows

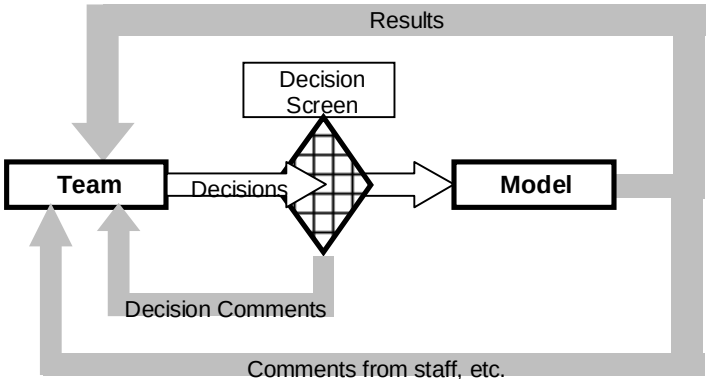


Figure 4.27b: Direct Use Information Flows

The difference between figures 27a and 27b, is that for Tutor Mediated simulations, the trainer is directly in the feedback loop and so can adjust pressure on the learners and take advantage of learning opportunities by providing appropriate cognitive and affective feedback. For Tutor Mediated simulations, proactive feedback can consist of challenges, coaching, comments and providing additional (business analysis) reports.

Design for Cognitive Processing

Learning using simulation is based on the Kolb Experiential Learning Cycle but unfortunately there is a risk that this will be *short-circuited* with the learners oscillating between Active Experimentation and Concrete Experience (Figure 4.28).

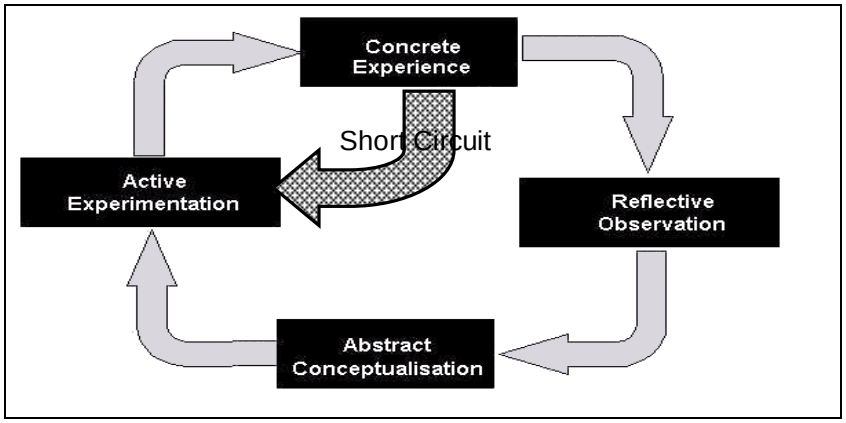


Figure 4.28: Short Circuited Experiential

For business simulations, a short-circuited experiential is characterised for Direct Use simulations by learners entering decisions and simulating without spending sufficient time analysing results and planning. For Tutor Mediated simulations a short-circuited experiential is characterised by learners making and submitting decisions early. My experience running simulations suggests that there are several causes for the problem.

- The simulation may be or perceived as too complex
- Workload may be too great
- Participants try to *beat the model*

Too Complex Simulation

If the simulation is or is perceived as too complex, participants are not able see causes and effects and do not feel that they know what to do – the obvious solution is to ensure that the simulation takes into account participants' prior learning and as necessary provides support. This was the situation for the S.E.E.D. simulation where the participants were assumed to have little or no business knowledge and experience. For S.E.E.D., the problem was mitigated by introducing complexity progressively and by including comprehensive on-line advice and explanations.

Too High Workload

If the workload is too high, participants do not have sufficient time to *think through* the problem facing them. This was a potential risk for the DISTRAIN simulation where additional decisions were added to an existing simulation and where the time could not be increased. For DISTRAIN the problem was alleviated by increasing the number of decisions made as the simulation progressed. However, work-overload during the initial decision periods is potentially a major problem. When piloting the simulation it is necessary to check that the initial workload is not excessive.

Beating the Model

If the participants treat the simulation as a game, they will try to *beat the model.* As an engineer I can say that this seems to a characteristic of engineers (it also seems a characteristic of MBA and university students – but this may be because of their lack of business experience and maturity). This cause can be overcome by having a cost associated with each decision-simulation step. As the target audience for the Prospector simulation would be engineers, architects, scientists, etc. this was perceived as a potential problem. Also as Prospector was to be a process simulation where participants make direct use of the simulator the processing cycle could not be not be constrained

and meant that participants had the freedom to oscillate between decision-making and simulation. Here the problem was overcome by making every decision take *management time* and this being a limited resource. So whenever a team made a decision they worried about running out of the *management resource.* This meant that they did not *waste* the resource making decisions to *break the model.* In the event, the amount of management time was significantly more than needed and to-date no team has run out of management time.

Overcoming the experiential *"short-circuit"*

For Financial Analysis (a planning simulation) teams were constrained to making no more than ten plans and this forced them to think before making decisions. At a time when software is designed with *undo* facilities this encourages *"doing before thinking"* (Hall, 1995b). However, with simulations learners must think before action an *undon't* approach is necessary.

Attempting to *break the model* is much less of a problem, where as teams make decisions, the business progresses over time. This is because, like the real world, if you make a bad decision, you have to live with it. In over thirty-five years experience, I can only think of two occasions where participants *broke the model.* And, one of those occasions was when I was playing a game designed by someone else!

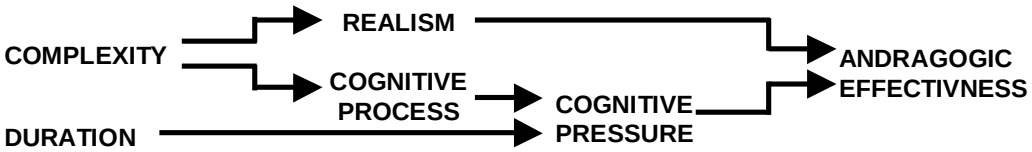


Figure 4.29: Complexity/Duration/Effectiveness (Hall & Cox, 1994)

Hall & Cox (1994) analysed a range of simulations and found that the number of decisions were highly correlated with the duration necessary to provide learning and from this derived a regression formula (Figure 4.30).

Duration (hours) = 0.829 x Number of Decisions – 0.355

Figure 4.30: Formula Linking Number of Decisions to Duration

However, some caveats about this formula. First, all these simulations had highly *granular* decisions. By making some decisions less granular, you can save time (for example, appropriate use of low granular decisions for SEED reduced duration by about 50%). Second, by introducing decisions and results as the simulation progresses so that focus changes across issues, time can be saved. For example, the duration of DISTRAIN was reduced from about 14 hours to eight hours. Finally all these simulations were run in a single session instead of spread over a course or a semester. If a simulation is spread, learners will consciously and subconsciously reflect on the simulation and conceptualise. As a result, a simulation that is to be spread can and should be more complex than one run in a single session (otherwise learners will not be sufficiently challenged and this will lead to disaffection). Thus, the Manner of Use (described next) has implications.

Design for Manner of Use

Simulations are used in a variety of ways and these have an impact on the design. In particular there is the extent to which the simulation addresses learning needs and where appropriate relates to a course. This section explores the issues associated with simulations used as a:

- Course Finale
- Course Theme
- Course Starter (icebreaker|)
- Course Break
- Reinforce a Topic
- Stand Alone Workshop
- Business Conference/Promotional Contest
- Assessment/Development Centre

Course Finale

Where the simulation is used as the Course Finale (capstone) it is important to ensure that it relates to and serves to integrate the elements of the course as far as possible. (But, it is likely that the simulation *will not* and *cannot* link to every session.) To ensure most effective use of learner time, the simulation should *not* introduce new issues and knowledge not covered by the course – in other words, it must focus on the course.

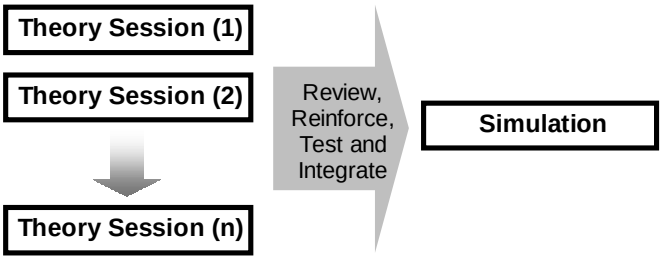


Figure 4.31: Linking Course Finale Simulation to the Course

My Technique simulation was especially developed as the course finale for a high technology multinational company to tie together a two-week General Management course for middle managers. Reflecting course content the simulation covered strategy, finance, marketing, operations, product development, business process re-engineering, business research and team working.

Depending on the type of course, the simulation may be a Tutor Mediated simulation (where a single microcomputer and printer is used to process the decisions of several teams that a competing in the same marketplace(s)) or a Direct Use simulation (where each team uses a microcomputer independent of the others).

Course Theme

Here the simulation runs throughout the course and is used to test, reinforce and embed knowledge as it is introduced as well as (possibly) introduce the next topic (Figure 4.31)

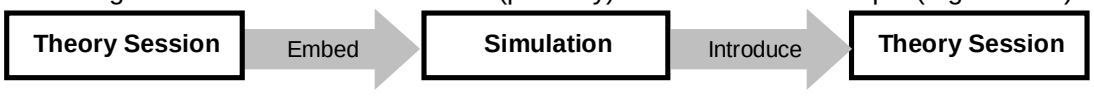


Figure 4.32: Using a Simulation as a Theme

This involves timing the introduction of decisions and results relative to the course plan.

Depending on the type of course, the simulation may be a Tutor Mediated simulation or a Direct Use simulation.

Course Starter (Icebreaker).

The simulation is used at the start of a course to help assess learners' prior knowledge, build the team and introduce the course.

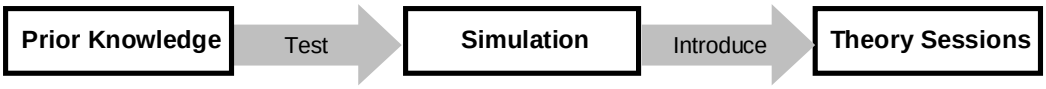


Figure 4.33: Using a Simulation as an Icebreaker

The simulation content must match to the required level of prior knowledge *relative* to the course. For example my Financial Analysis simulation was used to assess the prior knowledge of learners on an "Advanced Financial Appreciation" course. The rationale behind this was delegates needed to have knowledge of basic financial accounts (Balance Sheet, Income Statement or Profit and Loss etc.), Financial Measures (ROI, Profit to Sales, etc.) etc. but because of the nature of the course there was a risk that delegates did not have the necessary prior knowledge. So the simulation not only identified any remedial learning needs but also the delegates who had significant prior knowledge and could be used as a resource.

Depending on the type of course and the time available, the simulation may be a Tutor Mediated simulation (where a single microcomputer and printer is used to process the decisions of several teams that are competing in the same marketplace(s)) or a Direct Use simulation (where each team uses a microcomputer independent of the others).

Course Break

The simulation is designed to act as a break between two parts of a course serving to revise, refresh and integrate the earlier part and introduce the next part.

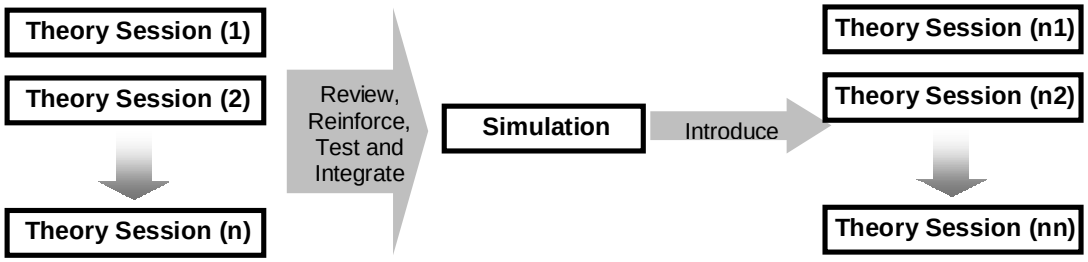


Figure 4.34: Using a Simulation to break up a course

For example, Product Launch was used on an Executive MBA program involved several residential workshops interspersed with E-learning activities. Each residential workshop represented a stage in the programme. One stage focussed on team working and behavioural aspects of management and the next on finance and marketing. To provide a link between the two, at the start of the *second* workshop, the business school used my Product Launch simulation to refresh team working and behavioural aspects and to introduce finance and marketing.

Depending on the type of course and the time available, the simulation may be a Tutor Mediated simulation (where a single microcomputer and printer is used to process the decisions of several teams that a competing in the same marketplace(s)) or a Direct Use simulation (where each team uses a microcomputer independent of the others).

Reinforce a Topic

The simulation is designed to embed and test the understanding of a specific topic before moving on.

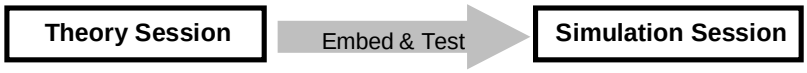


Figure 4.35: Using a Simulation to Reinforce a Topic

For example, on a *Finance for Non-financial Managers* course, my Operations simulation was used to reinforce forecasting and budgetary control and provide a break from the formal sessions. Each team used their own microcomputer to forecast sales for the next year, prepare a budget and then implement it for a simple manufacturing unit.

Using a simulation in this way ensures that theory is transformed into practice and *tested*. If indicated and necessary, remedial teaching can be done. Because of time pressures it is likely that this will be a Direct Use simulation rather than a Tutor Mediated simulation.

Stand Alone Workshop

The simulation is run as a stand-alone workshop to develop business knowledge and, optionally, refresh prior knowledge and identify future learning needs.

Figure 4.36 A Simulation on a Stand Alone Workshop

The Executive Committee of Gambro AB (a large medical company) identified the need for a simulation (Stokoe & Hall, 2007) for their senior management because:

- Only they had an overall view of how the organisation functioned as a whole.
- Executives were excellent in their specialities but did not have a good understanding of the entire entity nor of the financial impact their divisions.
- There was little interaction between different divisions
- They wanted to move from a product-oriented to a service-oriented organisation.
- Wanted sales people to move from selling individual products to selling complete systems and their associated services.
- And wished to stress the need for financial excellence and cash generation.

Commonly, for a Stand-Alone workshop is a Tutor Mediated simulation is used. But occasionally a Direct Use simulation is used. As, besides simulating interactions between teams in marketplace(s), a Tutor Mediated simulation only needs a single microcomputer and printer this may be logistically easier where the simulation is run in a hotel or conference centre.

A variation of this simulation is where it is run over several weeks where remote teams submit decisions that are then processed and results returned. (Gambro used the simulation on one-day workshops and remotely. But where it was run remotely over several weeks, each team had access to a *mentor* - a senior manager whose role was to coach and challenge the learners.

Business Conference/Promotional Activity

The simulation is used as part of a business conference or to promote a company to its customers by providing a fun, business oriented team/relationship building activity.

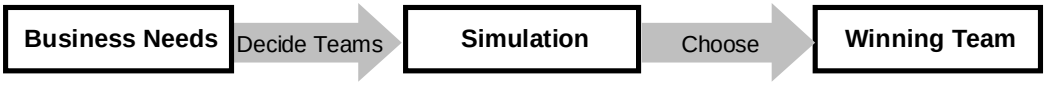


Figure 4.37a: Business Conference Simulation

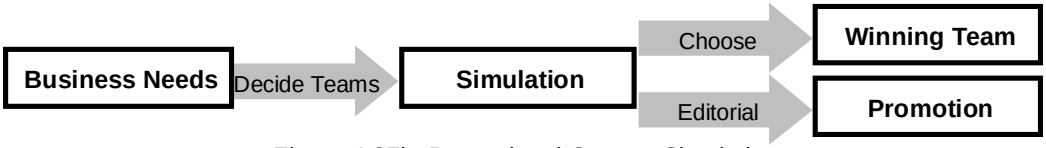


Figure 4.37b: Promotional Contest Simulation

Although the prime purpose is fun, where the simulation is used at an in-company conference (Figure 4.37a), there are likely to be other business needs (such as emphasising profits or good forecasting to sales people). Also (as is usual) the group will have a wide range of prior knowledge and experience, this must be taken into account to ensure that those with a lack of knowledge are not overwhelmed and those with significant knowledge bored. Probably, the best way to overcome this problem is by choosing teams with a mix of abilities. As a winning team must be chosen the simulation should provide one or more result that can be used for this.

Where the simulation is used to promote a business to its clients (rather than with in-company staff), besides choosing a winning team, there is the need to ensure that it promotes the sponsoring company (Figure 4.37b). An example of this was the development of my Management, Retail and Service Challenge simulations for use on the Benson & Hedges Management Challenge in the Arabian Gulf (Hall, 1989). Here besides rigorously checking the simulation, reliability was vital and so the simulation must be piloted several times before being used. Additionally, to ensure that we got excellent editorial coverage in the press, besides taking representatives of the promotional agency with us, we had a *tame* journalist to write copy. This resulted in about 11,000 column centimetres of *editorial* coverage each year!

Because of the competitive nature, numbers and logistics, it is likely that the Business Conference/Promotional simulation will be a Tutor Mediated simulation.

Assessment/Development Centres

The simulation is used as part of an Assessment/Development Centre to assess the competencies of the participants and their development needs.

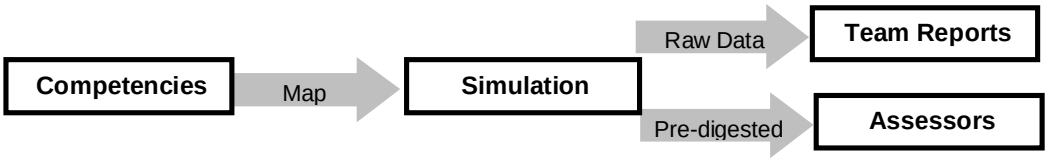


Figure 4.38: Assessment/Development Centre Simulation

The simulation should reflect the industry of the people being assessed, the issues facing it and relate to the competencies being assessed. Beside the normal team reports, a special set of reports should be provided to the assessors replicating the team's reports but, additionally, providing pre-digested indication of the issues that the teams should be discussing and showing their strengths and weaknesses.

To enable the production of the assessor reports, the simulation should be a Tutor Mediated rather than a Direct Use simulation. (Using a Direct Use simulation where the participants enter decisions may move their focus away from their management task towards using the computer and so distort their assessment.)

A variation of the Assessment/Development Centre simulation is where a simulation is used as part of a workshop for potential graduate employees. The explicit purpose is to enthuse prospective graduate employees about business and the company. But there is a tacit purpose – assessing competencies and team working skills. Thus the simulation must combine aspects of the Business Conference simulation and this Assessment type of simulation.