CORPORATE CARTOONING: THE ART OF COMPUTERIZED BUSINESS SIMULATION DESIGN

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ABSTRACT

Business simulation design is a combination of art and science. And, although the science aspects are arguably domain specific this paper suggests that the art aspects are not. It argues that computerized business simulations are a sequential art form that parallels the strip cartoon or comic. And that this parallel can be used to explore the art of computerized simulation design and, especially, the tacit and instinctive aspects of simulation design that can be made explicit using the sequential art knowledge base.

The paper explores how the relationship between the comic's pictures and words parallel the business simulation's models and interactions with learners. Using this parallel the paper argues that it is possible to classify and position simulation models in terms simplicity and stylization. And decisions and results (interactions) in terms of ambiguity and form. Beyond this, the paper draws a parallel between the comic's panel or frame and the simulation's period. And explores the parallel between the comic's transitions between frames and the different ways the simulation progresses period-to-period. Also, just as the comic artist must consider how the gutter enforces closure, the simulation designer must consider how to ensure reflection. Next, the paper explores the parallel between the cartoon's verbal/visual relationships the simulation's model/interaction relationships. Finally, the paper discusses how balance between the clarity and intensity of a comic is replicated in the need for a simulation to balance learning and engagement.

In summary, the paper explores the parallel between the strip cartoon or comic and the mathematical equivalent – the business simulation-game.

Key Words: comics, cartoons, design art

INTRODUCTION - WHY CORPORATE CARTOONING?

Eisner (1985) uses the term *sequential art* in the context of the comic (strip cartoon) but McCloud (1993) refines the definition for comics to *"juxtaposed pictorial and other images in deliberate sequence, intended to convey information and/or to produce an aesthetic response in the viewer"*. Likewise, with business simulations we are looking at how a sequence of interactions with mathematical algorithms (models) are used to derive didactic responses from the participating learners.

Why can business simulations be seen as the mathematical equivalent of the cartoon or comic strip*?*

1. Eisner (1985) states, *"In the main comics are a representational art form devoted to the emulation of real experience"*. And we suggest that this is a definition that can be applied equally to business simulations. Except that, for simulations although the desire is still to *emulate real experience*, the representation is mathematical and interactive rather than graphical and verbal.

2. The people and situations drawn in a cartoon strip are simplified and stylized representations of reality. The large heads and small bodies of the characters in Peanuts do not rob from our enjoyment and understanding of the strip (Harvey, 1994). Because of this stylization, Lucy is not any less real than most little girls. Rather, for Lucy, this stylization and simplification reveals the essentials of little girldom, as we are not confused with superfluous detail. Peters et al (1998) suggest for simulations *"the design process of a (business) game is based on three principles, namely, reduction, abstraction, and symbolization"*. Similarly Hall (2001) suggests that *"a well-designed business simulation is a stylized and simplified replica of the real corporate world that reveals defined business essentials"*.

3. The cartoon strip leads, frame by frame, to the ultimate denouement, Gestalt, or Aha (described by Harvey as *"the punch line"*). Likewise, the computer business simulation takes the participants through a series of steps to one or more Gestalts and in doing so builds learning and tension over time.

4. The strip cartoon is engaging and *fun* but also insightful and at times disturbing. Again the computer simulation must be engaging (Quinn and Conner, 2005) and insightful. Its design must not just be focused on cognitive development but also must address the issues of affection (Hall & Cox, 1993). As a corporate simulation user stated recently *"Throughout the training, there were never problems with people checking email, voicemail and so on. Most would work voluntary through lunch on their (virtual) business"* (Schneider Electric facilitator) (Hall, 2006) – and this observation was about sales people!

5. The strip cartoon is memorable. The author still remembers clearly, a Peanuts cartoon from the mid-

1960s showing *the gang* dancing around a Maypole. From frame to frame the pace of the dance becomes more and more frenzied. Until, in the final frame, the gang is trapped against the Maypole entangled in the ribbons. All are crying "Mayday", referring both to the date of the activity and the international cry for help! – a very, very clever and insightful visual/verbal joke. Again, the deep cognitive processing engendered by participating in a simulation ensures that the activity is memorable. (Practice by doing provides a 75% retention rate compared with the lecture's 5% retention rate (Motorola University, 1996).)

6. The computer business simulation has constraints just as the strip cartoon. For the strip cartoon (Harvey, 1994), the constraint is space - the number of column inches (or centimeters) that can be dedicated to the strip by the newspaper. For the business simulation, the major constraint is duration - the amount of time that can be budgeted for the activity (Hall, 2003). For the strip cartoon, the space constraint has meant that the comic strip has evolved from complex realistic drawings to simple and stylized drawings (Harvey, 1994). In a similar manner the computer business simulation is evolving from designs that focus on developing a complex representation of reality (the model) to one where the design focus is on learning purpose and short duration (Hall, 2005).

Thus we argue that the business simulation is the mathematical equivalent of the strip cartoon or comic and that by applying cartoon design concepts to business simulations we can better understand the *art* of simulation design.
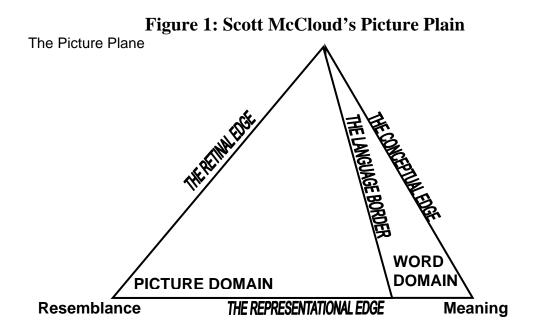
THE VOCABULARY OF COMICS

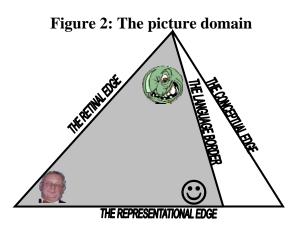Scott McCloud (1993) analyses cartoons (comics) in terms of a "Picture Plane" (Figure 1).

At the bottom of the Picture Plane is *the Representational Edge.* As you move from left to right across this edge you move between *reality* towards *meaning* where the pictures are *received information* and words are *perceived information* (McCloud, 1993).

The Picture Plane has two main domains. The area between *the Retinal Edge, the Language Border* and *the Representational Edge* is the cartoon picture domain. And the area between *the Language Border, the Conceptual Edge* and *the Representational Edge* is the cartoon word domain.

For the picture domain McCloud explores abstraction along the horizontal and vertical axes. Horizontally the cartoon picture becomes progressively simpler (iconic abstraction). On the far left, a picture has a photographic quality. But on the far right, it is the simplest line drawing. Vertically, McCloud suggests a non-iconic abstraction where there is a movement away from meaningful representation towards surrealism. In figure 2 this is illustrated by the faces - photograph like (bottom left), smiley (bottom right) and the surrealistic face at the top.

Similarly, the Word Domain differentiates between simple, direct words and more elaborate story telling (McCloud, 1993).

Figure 1: Scott McCloud's Picture Plain

The Picture Plane

THE RETINAL EDGE

THE CONCEPTUAL EDGE

THE LANGUAGE BORDER

PICTURE DOMAIN

WORD DOMAIN

Resemblance   THE REPRESENTATIONAL EDGE   Meaning

Figure 2: The picture domain

MAPPING THE SIMULATION TO THE CARTOON "PICTURE PLAIN"

For the simulations a *Simulation Plane* (Figure 3) is envisaged that equate to the graphic cartoon's *Picture Plane*. Except that here the *Picture Domain* transforms into the *Model Domain* and the *Word Domain* into the *Interaction Domain.*

The Simulation Plane parallels the Cartoon's Picture Plane with the *Retinal Edge* transforming into the *Mathematical Edge,* the *Language Border* into the *Interaction Border* and the *Conceptual Edge* into the *Learning Edge.* The *Representational Edge* remains the same but here extends from *Replication* to *Learning* (rather than *Resemblance* to *Meaning*). But, we argue that the simulation plane does not converge to an apex. Rather there is an upper edge - the *Figurative Edge,* where the model is fully metaphorical or emblematical and the interactions are completely unambiguous.

The Interaction Domain interacts with the Model Domain with the decisions. And the Model Domain interacts with the Interaction Domain with outcomes (business results).
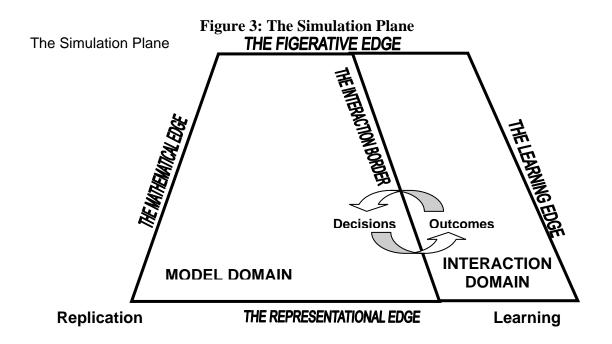
MODEL DOMAIN

The model domain consists of the mathematical algorithms, data and parameters that define the pre-planned (computer) process aspects of the simulation.

The **Horizontal Complexity Axis** ranges from exact replication (left) to simplicity (right)**.** And the **Vertical Stylization Axis** ranges from no stylization (bottom) to extensive stylization (top).
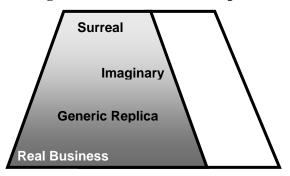
Also, the model domain can be seen as having several *aspects* – the scenario aspect, the content (subject) aspect and the calibration aspect.

The **Scenario Aspect** (Figure 4) defines the extent to which the business situation is stylized and there are several levels. At the bottom, the model attempts to replicate, exactly, an actual business. Above this the model is progressively stylized. First into a replica of a generic industry sector. Then an imaginary business with invented products and processes. And finally, perhaps, to the surreal. This aspect expands on the "continuum from industry specific to generic" (Biggs, 1990) to include imaginary and surreal.

The **Content (Subject) Aspect** defines the extent to which certain issues, processes and concepts are emphasized and included at the expense of others. So, for example, a total enterprise simulation would attempt to provide "an overview of general business management" (Biggs, 1990). In contrast, a functional simulation (Biggs, 1990) would cover a single functional area (such as manufacturing or sales) in depth. Addition simulation types

Figure 3: The Simulation Plane
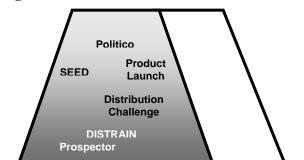
Figure 4: Model Scenario Aspect

include concept (Leach, et al, 1983), planning simulations (Malik et al, 1997) and process simulations (Hall, 2005).

The **Calibration Aspect** defines the extent to which the parameters used by the simulation are exaggerated. This exaggeration is to enhance both cognition (understanding) and affection (feelings). To enhance cognitive understanding, the impacts of decisions on outcomes may need to be amplified to ensure that learners can identify the causal links between decisions and outcomes. Simulations that are spread across the model domain can illustrate this (Figure 5).

At the bottom-left is Prospector a complex stage-gate process simulation. Although this models a stage-gate process in detail, it is still stylized and simplified. Higher and towards the right, is Distribution Challenge (generic total enterprise simulation that replicates a distribution company). In between, the DISTRAIN simulation is a customized version of Distribution Challenge that replicated a specific distribution company. A customization that was more complex and less stylized and so positioned below and to the left of Distribution Challenge.

Figure 5: Simulations on the Model Domain

Both SEED and Product Launch involve imaginary products. For SEED (a complex entrepreneurial planning simulation) the product is a high-tech *Cuddl-Etoy* and for Product Launch (a concept simulation exploring the Product Life-Cycle) an innovative self-heating soup. The imaginary nature of their products, allow business issues to be explored without the pre-conceptions that might exist and distort learning if actual products had been chosen. At the

top of the model domain is Politico, a simulation that *surrealistically* models national politics and where the basic assumption is that political success and power comes from the *timing* of statements about policy and that actual political actions are completely useless.

The position in model domain raises questions about validity, specifically are simulations located towards the bottom left more valid than simulations located to the right and above. Harvey (1994) states *"Comics can be (and too often are) evaluated on purely literary grounds"* and argues that this is wrong. This parallels a common assertion that *"Management simulations are valid pedagogical tools provided they are complex and realistic"* (Miller and Leroux-Demers, 1992). Harvey then continues by suggesting that such an evaluation *"ignores the purpose served by the visuals – the story or joke that is being told"*. Equally, for simulations a focus on reality and the associated complexity ignores their purpose – learning. With the exception of Politico, as the simulations illustrated in figures 5 have been used widely and successfully on business training courses, it seems reasonable to suggest that simulations like cartoons are valid across most of the model domain.
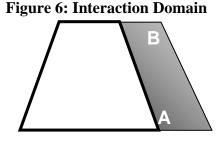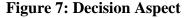
INTERACTION DOMAIN

Defines the process aspects of the simulation and comprises the decisions and outcomes from the simulation - the **decision aspect** and the **outcome aspect.**
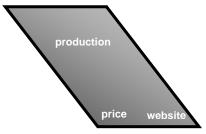
The **Vertical Axis** defines the degree of *ambiguity* – from very ambiguous at the bottom to unambiguous at the top. The **Horizontal** Axis defines the *form* of the decisions and outcomes. Form ranges from complex (on the left) to simple or basic (on the right). And one suggests that decisions or outcomes in the bottom left corner (A) require the greatest cognitive processing. And those in the top right corner (B) the least.

Decision Ambiguity defines the extent to which the impact of the decision is uncertain. Thus the outcome from a production decision would be reasonably certain. (Although where there could be a material or capacity shortages it would be ambiguous). But, the outcome of a price decision would be more ambiguous as it would be difficult to forecast the impact on sales demand.

Scherpereel (2006) categories decisions in terms of three orders (routine deterministic (1), those with probabilistic aspects (2) and complex decisions requiring heuristic solutions (3)) and these can be seen as bands down the decision aspect with progressively increased cognitive processing requirements.

Figure 6: Interaction Domain

Figure 7: Decision Aspect

Decision Form is defined in terms of the range of possible values and the choices possible. Thus, a price decision would have a wide range of possible values.

But whether or not to have a web site has have two possible values (Yes or No). Thus the Decision Form extends from where any number can be entered to a restricted range on numbers to multiple choices and finally a binary choice.

One suggests that as the time taken to make a decision is reduced as it's form is simplified and this provides another way to reduce duration. SEED illustrates this (figure 8). Here, except for the price and advertising decisions, all decisions were multiple-choice. (Ranging from a maximum of twelve choices (Launch Month) to two decisions (the Yes/No decisions). (And, this reduced SEED's duration from two days to six hours.)

Figure 8: SEED Marketing Decisions

Marketing Plan			
	Plan 1	Plan 2	Plan 3
Launch Month	June	July	May
Number in Range	4	7	2
Sell to Retailers	No	Yes	Yes
Web Site	Yes	No	Yes
Web Price	69.95	0.00	69.95
Retail Outlet Price	0.00	69.95	69.95
Price to Outlets	0.00	29.95	29.95
Advertising Spend	0	70000	50000
Public Relations	None	Launch	Both
Enhanced Web Site	Yes	No	Yes
Point of Sale Display	No	Yes	Yes
Packaging	Plain	Fancy	Fancy

Deciding Ambiguity and Form: If unambiguous and simple form decisions (top right) are made in the shortest time and ambiguous and complex form decisions are made in the longest time, this provides a way of matching decision form and ambiguity to learning importance. Decisions key to learning purpose (Scherpereel's complex decisions requiring heuristic solutions) need to be positioned at the bottom of the Decision Aspect. And decisions that are necessary but subsidiary to learning can be less ambiguous and should be positioned higher in the domain. Finally, a judgment based on duration constraints needs to me made about the decision's form.

Outcome Form (horizontal axis) defines the extent to which the outcome data is refined or processed into a new form (result table, graphs, text, pictures, sound, animation

etc.) This is illustrated in Figures 9 and 10. In Figure 9, the Balance Sheet (9a) provides raw, unrefined data. But, processing the Balance Sheet with the Income Statement produces a series of Profitably Measures (9b) that are to the right of the raw Balance Sheet data on the Outcome Aspect Domain (figure 10). The Profitability Trend (9c) moves further to the right. And processing the trend in to graph (9d) moves the result even further to the right. Finally, making comments on the profitability (9e) involves further processing and movement to the right.

Figure 9a: Raw Data

Total Equity
Total Liabilities
Total Fixed Assets
Total Current Assets

Figure 9b: Refined Data

Return on Assets	20%
Return on Equity	15%

Figure 9c: Trend over time

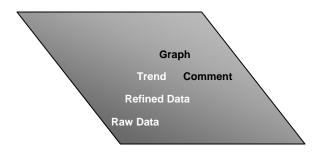| Year	1	2	3	4
Return on Assets	20%	18%	9%	11%
Return on Equity	15%	12%	6%	7%

Figure 9d: Trend Graph

Figure 9e: Comments on Measures

Accountants feel Return on Assets may be poor
Return on Equity is poor

Figure 10: Outcome Positioning

Outcome Ambiguity (vertical axis) defines the extent to which outcomes are difficult to interpret and require further processing. Figure 10 positions the reports shown in figure 9 across the Interaction Domain.

Except for Comments, ambiguity is reduced as outcomes are processed further. But, for Comments, ambiguity is affected by the choice of words. So, words like *feel* and *may* are more ambiguous than words like *are* or *is*. (In 9e the first comment is more ambiguous than the second.)

As it is plausible that results must be neither too ambiguous nor too prescriptive, it is inappropriate to have outcomes at the bottom (totally ambiguous) or the top (totally prescriptive).

In a similar position to Comments and with a similar spread of ambiguity there are other Output Forms – graphics, pictures, sounds, music and animations.

For example, with Prospector, the *virtual* customers' responses to negotiation proposals are shown as a series of colored bars that range from three red bars (totally unacceptable) through orange (possibly OK) to three green bars (very, very acceptable). Again for Prospector, whenever a company wins a contract, applause is heard. For SEED, when the learners start using the simulation it plays "The Teddy Bears' Picnic" thus emphasizing the fun aspects. (And, where the simulation is run with all the teams in a large room, perhaps warning the trainer that a team may have spent insufficient time preparing before making their first decision.)

In contrast to most of the Output Forms (described in Figure 9a-d) that concentrate on numeric feedback, pictures, sounds, etc. and comments provide the opportunity for subjective, non-numeric cognitive *and affective* feedback.

THE PANEL OR FRAME

Just as sequential art (the comic) consists of a series of panels, the simulation consists of a series of periods or stages. And as a common structure for the strip cartoon (rather than comic book) is three or four frames, a common structure for a simulation is six to a dozen periods or stages.

For strip cartoons the panel or frame is as important an element as the each frame's content. As a result, Eisner (1985) dedicates a full chapter (and nearly 40% of his book) to frames discussing them in the context of encapsulation, control, creation, container, structural support, narrative device, emotion etc. Some of there translate directly to business simulations and some seem not to but *may* provide insights that can be applied to new forms of simulation. McCloud (1993) devotes less space to frames but discusses them in terms of time describing each as framing "*a single moment in time*" and this parallels the simulation's decision-making cycle where typically a business is moved forward one year, quarter or month.

For simulations, the parallels between the panel and the decision-period exist in terms of transitions as the comic/simulation progresses, encapsulating time and closure/reflection.
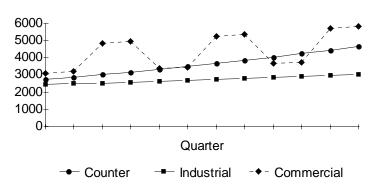
TRANSITION/PROGRESS OVER TIME

McCloud (1993) discusses the comic in terms of the transitions from panel to panel and suggests several types of transition linking one panel to the next. In a similar manner, simulations *progress* from period-to-period or stage-to-stage in several ways and these parallel McCloud's transitions (Figure 11).

Figure 11: Types of transitions and progressions

Cartoon	Simulation
Moment to Moment	Economic Progression
Action to Action	Task Progression
Subject to Subject	Issue Progression
Scene to Scene	Business Progression
Aspect to Aspect	Viewpoint Progression
Non-Sequitur	Ad Hoc Progression

Figure 12: Economic Progression

Demand Pattern

Quarter

◆ Counter   ■ Industrial   ◆ Commercial

Moment-to-Moment Transition/Economic Progression

The Moment-to-Moment Transition moves a single subject forward over time and is paralleled by Economic Progression that defines how the economic situation changes independently of the decisions made. For example, with DISTRAIN; the market sectors (Counter, Industrial and Commercial) each had an underlying growth rate and the Commercial sector had a significant seasonal pattern (Figure 12).

Action-to-Action Transitions/Task Progression

In contrast to Moment to Moment transitions that concentrate on a single subject, Action-to-Action Transitions move between subjects with substantial changes in these from panel to panel. In a similar manner, Task Progression defines how the business decisions evolve as the simulation progresses and so parallels McCloud's Action-to-Action transitions. For SEED (Figure 13), the simulation moves from researching the business, to market planning and then to operations and financial planning. Task Progression involves introducing new decisions (and associated reports) as the simulation progresses, with each new decision introducing a new task to discuss and learn about.

Subject-to-Subject Transition/Issue Progression

Issue Progression occurs when there is a step change in the issues explored by the simulation and parallels McCloud's Subject-to-Subject Transition This may be done through a change in the environment (as is the case with Product Launch where competitors enter the market about half way through the simulation – causing an increase in price sensitivity and a reduction in promotion sensitivity). Or a more complex introduction of issues as illustrated by Prospector (Figure 14).

Scene-to-Scene Transition/Business Progression

Business Progression defines the impact of the decisions on the outcomes period by period and parallels McCloud's Scene-to-Scene Transition that involves significant changes over distances or time. This is illustrated in the Product Launch simulation, where as the market is penetrated customer types evolve (as different types of customers adopt the product (Rogers, 1962). And as the customer base is penetrated this increases price sensitivity (Figure 15)

Thus this progression defines how the simulation responds dynamically to the decisions made. This is further illustrated by the first version of Product Launch where it was felt that customers would respond immediately to price increases but there would be a delay before they reacted to price reductions Although this delay was realistic it was so ambiguous that it was impossible for participants to visualize the impact of their price decision. Because of this, the delay in the response to price reductions was removed (stylization of the model to reduce ambiguity).

Aspect-to-Aspect Transitions/Viewpoint Progression

Aspect-to-Aspect Transitions involves looking at a *"place, idea or mood"* from different viewpoints (McCloud, 1993). Viewpoint Progression parallels this involving introducing new reports that provide new viewpoints on the business that is being run and are designed to promote discussions (This contrasts with Task Progression as that focuses on introducing new decisions and the associated reports are secondary to this.)

For example, Product Launch although the decisions do not change, the reports evolve from a single report to several (Figure 16). Where each report introduces a new concept associated with the Product Life-Cycle.
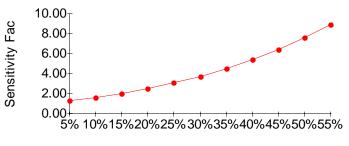
Figure 13: Task Progression

SEED – Tasks	
Period	Planning Options
January	Business Research and Policy Advice
February	As January plus Marketing planning decisions
March	As February plus Resource and Working Capital planning decisions
April onward	All decisions

Figure 14: Issue Progression

Prospector	
Stage	Issues
1	**Project Search**: deciding a policy for project size, experience, urgency and client type.
2	**Pre-qualification**: assessing project risk in more detail and deciding best fit.
3	**Tendering**: determining how to maximize profit while ensuring winning the bid
4	**Negotiation**: ensuring the best work schedule and cash flow

Figure 15: Business Progression

Penetration-Price Sensitivity Model

Figure 16: Viewpoint Progression

Product Launch – Viewpoint Evolution	
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

At period 3, providing a table of decision and result trends, encourages learners to start thinking about the longer term (rather than just the current period). At period 5, producing a report showing trends in marketing (price, promotion %, penetration %, market share % and sales demand) encourages the learners to think about how their marketing mix decisions are influencing sales. At period 6 the profitability report (showing trends in gross profit %, net profit % and return on investment) encourages discussion about profitability and how actions and the Product Life-Cycle have been affecting these.

Non-Sequitur Transition/Ad Hoc Progressions

The Non-Sequitur Transition is where there is no logical relationship between panels parallels the introduction of ad hoc changes (Ordway, 1977) or *shocks* (Snyder, 1999) as the simulation progresses. For example, in DISTRAIN it is possible for the trainer to override the pre-defined growth in sales demand (Figure 11) to simulate a disruptive event such as a hurricane. Moore (2007) warns about comic transitions that *"the problem is to move from one place or one time to another without doing anything violent or clumsy that would disturb the reader's thread of involvement"*. Although this problem also exists for all the simulation progressions, it is particularly true for ad hoc progressions where an in appropriate shock can cause disaffection (Hall and Cox, 1993).

Mix of progressions

Just as cartoons consist of a mix of transitions (McCloud, 1993), a simulation is likely to consists of a combination of progressions. However, by considering them separately, one can consider different aspects of the desired learning and the extent to which they interact and affect complexity.

PANELS AND STAGES – ENCAPSULATING TIME

The width of the cartoon frame (panel) is paralleled, for the simulation with the length of time between making decisions and receiving results (interactions). And as the width of a cartoon frame adjusts detail and hence pace (Moore, 2007) the duration of a simulation limits the amount of cognitive processing possible (Hall & Cox 1994). In turn, this defines the numbers and types of interactions (decisions and outcomes) that can be handled period-by-period and the cognitive pressure caused by the simulation. Just as for the cartoon *"each panel should frame only the minimal essentials of a scene – those elements necessary for maximum storytelling effectiveness"* (Harvey, 1994) and we replace the word storytelling with learning in this quote, the sentiment applies to simulation.

SPACE BETWEEN PANELS (THE GUTTER)

Both Eisner and McCloud emphasize the importance of the space between panels (the gutter) as a structural element. For simulations, space between decision periods has implications in terms of the necessity for reflection (Gosen & Washbush; 2005, Gosen, 2004) and the opportunity to plan for this and reinforce it. Where the simulation is spread over time this reflection can be at a subconscious level. And where reflection time is enforced it will be conscious. However, it may be necessary to use devices to enforce reflection. For example, at predefined times for the Prospector simulation *requests* from a virtual *parent company* (the trainer) are made to provide information (Figure 17). The reasoning was that this would force participants away from the Active Experimentation – Concrete Experience phases of the Kolb (1985) cycle to the Reflective Observation – Abstract Conceptualization phases of the cycle.

Figure 17: Reflection Triggers

Parent Company Reviews
1. Search Criteria Review
2. Pre-evaluation Criteria Review
3. Tender Criteria Review
4. Final Offer Review
5. Tender Price Review
6. Risk Level Review
7. Work Budget Review
8. Workload Review
9. Cash Flow Review

RELATIONSHIPS: MODEL AND INTERACTIONS

The relationship between the comic's words and picture is a vital design element. Eisner (1985) states that *"in sequential art the two functions are irrevocably interwoven"* and later heads a section with the title *"WORDS/ART: INSEPARABLE"*. Just as the relationship is vital for comics, so too for simulations the relationship between model and the interactions is vital. For comics, McCloud (2006) explores the balance in depth and suggests several categories of word/picture combinations (Figure 18) most of which have parallels for simulations.

For simulations, the situation is more complex, but even so there are some parallels.

Intersections are probably more frequent and represent the situation where a result is affected by several decisions or where a decision affects several results. Figure 19 shows a meta-view of the links between interactions (decisions and outcomes) and the model for the Product Launch simulation.

The cognitive importance of these intersecting links is illustrated by this quote, *"each decision needed to be accounted for by another to maximize impact. Schneider has been trying to teach thinking through the process for years – this class helped them understand"* (Hall, 2007).**Interdependent** model and interaction is where there is direct link between a (single) decision through the model to a (single) result (Figure 20). At the end of the Tendering Stage for Prospector participants must submit a price to the (virtual) customer and based on this the contract is won or lost.

Figure 18: Word/Picture Categories (Making Comics 2006)

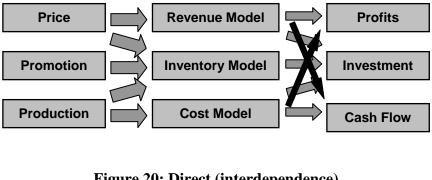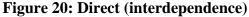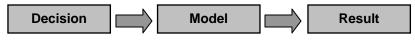| Category	Description
1. Word-Specific	Words provide all you need to know.
2. Picture-Specific	Pictures provide all you need to know.
3. Duo-Specific	Both send roughly the same message.
4. Intersecting	Words and pictures working together in some respects but also contribute independently.
5. Interdependent	Words and Pictures combine to convey an idea that neither would contribute independently.
6. Parallel	Words and Pictures follow seemingly independent paths.
7. Montage	Words and pictures combined pictorially.

Figure 19: Multiple intersecting links.

Price → Revenue Model → Profits

Promotion → Inventory Model → Investment

Production → Cost Model → Cash Flow

Figure 20: Direct (interdependence)

Decision → Model → Result

Word Specific is paralleled by the (Interaction Specific) situation where the model plays no part in the translation of decisions into outcomes (results) (Figure 21).

Figure 21: Interaction Specific

Decision → Result

The SEED simulation illustrates this where one learning objective was timely market and business research. And, if the appropriate market research is not performed it is not possible later to plan the business. So, for example, (referring back to Figure 13), if market size and price research is not done in January then during the following month (February) it is not possible to plan the market. However, the market research is not processed by the model but is immediately reflected back as information (to be used later by the model).
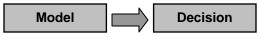
Picture Specific is paralleled by the (Model Specific) situation where the model drives the results (Figure 22).

Figure 22: Model Specific

Model → Result

At the end of the Product Launch simulation, the history of decisions and results are automatically analyzed and compared with prior runs generating a list of strengths and weaknesses.

Because the Interaction Domain has two aspects (Outcomes and Decisions) there is a second Model Specific situation where the model drives decisions (Figure 23)

Model → Decision

Figure 23: Model Specific

This occurs when the simulation model determines a situation that needs management action and so asks for a decision. For example, in the Beat the Boss simulation, if insufficient raw materials are purchased and there is an inventory shortage, the model asks the participants whether they wish to make an emergency purchase (at a premium price).

Parallel is paralleled for simulations by the situation where the model and outcomes follow seemingly independent paths. So, although for several periods, the response of the model to decisions and the outcomes are apparently not linked eventually, they dovetail. This is illustrated in the Product Launch simulation, where over time price and promotion decisions impact the degree to which the market is penetrated. And, although this has a short-term effect on profits, capacity need and cash flow, there is a long-term effect on competitive strength. An effect that becomes apparent and important when the (simulated) competition enters the market. At that time, if the market is not well penetrated, the Product Life Cycle is shortened and cumulative profit restricted.

Duo Specific occurs with simulations when the *same* message is provided in two (or more ways) to emphasize an issue and stimulate discussion. For example with the DISTRAIN simulation, participants routinely receive information about sales (at cost) and inventories that allows them to consider whether the inventory level is optimum. However, if inventories are well above the optimum to service sales demand the message "*Accountants feel Inventories seem high for …….*" is generated. (And, if inventories are well below the optimum level, the sales force comment.) Thus duo specific relationships allow the simulation designer to *emphasize* outcomes in order to force participants to focus on these.

The last comic word/picture relationship (**Montage**) occurs when the words take on picture qualities. For simulations, it is, perhaps, replicated using graphics, pictures, sound and music. For example, impending bankruptcy in the Beat the Boss simulation is indicated by the theme music from Jaws (indicating the threat and, perhaps, the persona of banks).

Just as simulations (and models) involve several progressions (transitions), within a simulation there will be several types of relationship between the model and interactions.

BALANCE: LEARNING AND ENGAGEMENT

One major benefit derived from simulation use and a design necessity is engagement. However, it is possible for this to be at the expense of learning (Cryer, 1988; Jones, 1989; Lundy, 1984). And so simulation design must balance learning (cognitive development) and engagement (affection). This is paralleled in cartoons with the need to balance *Clarity* and *Intensity* (McCloud, 2006). He describes *Clarity* as *"making reader comprehension your ultimate goal"*. As such it directly equates to the simulation's learning purpose. And, he describes *Intensity* as those elements of a cartoon *"which add contrast, dynamism, graphic excitement or a sense of urgency"*. And he continues to describe *Intensity* as the techniques that attract and excite readers *"as soon as they pick it off the shelf"*. In other words those elements of the cartoon that parallel engagement for simulations.

Just as McCloud discusses a philosophical divide between those who advocate *"a thrilling ride"* and those who believe that the emphasis should be on the story (its characters and events), it seems that there are two opposing views for the design of business simulations. There are those who advocate graphic richness (as found in video games) and those who take a *leaner* view. Those who take this view justify it based on the premise that the cognitive challenge of running a successful (virtual) company is enough and that the excessive and, additionally, inappropriate use of graphics can detract from learning (Sloutsky et al, 2005).

In the context of cartoons, McCloud argues *"the principles of pure, clear story telling should be your starting point"* and, for simulations, this author believes that learning purpose should be the starting point.

CONCLUSIONS

Just as the cartoon combines words and pictures, the simulation combines a model with interactions and is a mathematical facsimile of the strip cartoon or comic strip.

The simulation plane allows one to make informed artistic judgments about stylization and simplification (model domain) and the extent of abstraction and form (interaction domain). When designing the simulation model there is a need to decide the extent to which the model is a simplified replica – a process that involves deciding what should be included and what is unnecessary. Likewise, there is the need to decide the extent to which the model is stylized. However, just as we have no cognitive problem associated with a cartoon's simplification and stylization, one suggests that for business simulations learners will have no cognitive problems with a move away from *reality*. And,

just as this helps the cartoon provide engaging insights this helps the business simulation in the same way.

Just as the structure of the cartoon (the panels or frames and their relationships) affect the way the *story* evolves, ensures engagement and provides insights, the simulation's decision periods build learning, ensure engagement and provide insights. Further, the classifications of progressions (transitions) and the relationships between the model and interactions provide a means of evaluating and planning a simulation's design

A key cartooning concept is that the words and art are inseparable (Eisner, 1985) so too it seems that the model/interactions are inseparable for business simulations and a design and discussions of design must consider how these interact and complement each other. This inseparability is important when it comes to judging the quality of a simulation and like the cartoon, where Eisner (1985) states, *"great artwork is not enough"* an incredibly real model is insufficient to provide effective learning.

Equally, just as there are questions associated with the balance between visual and verbal (Harvey,1994) there are questions about the balance between the model and interactions. So, for example, a very intricate model may overwhelm the interaction aspects of the simulation. And, likewise a simplistic model may underwhelm the learner.

By using knowledge from the graphic strip cartoon (comics) domain the, often, tacit aspects of the design of computer business simulations can be exposed and explored. For example, one might question the extent to which the simulation model can be stylized – is it possible to develop business simulations that deliver learning but where the scenario is surreal? Also, is it possible to use cartoon practice to develop new forms of business simulation. And, although this paper explores the strip cartoon (with incorporating a series of panels or (for the simulation) a series of decision-periods), is it possible to create a simulation that consists of a single set of outcomes and so parallel single panel cartoons (such as the Far Side cartoons)? Or, at the other extreme, is it possible to create a simulation that replicates the graphic novel?

Bellman et al (1957) when describing the design of what is regarded as the first business simulation for business training, suggested that *"Making models, mathematical or otherwise, of complex systems is an art with a small amount of science to guide one."* And, the author believes that this still true today but, by drawing a parallel to the strip cartoon or comic, it is possible to explore explicitly the *Art of Business Simulation design.*

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