Chapter 11: Choosing Business Simulations

Contents

Introduction

This chapter covers choosing a simulation for a specific development situation based on:

- **DEVELOPMENT OBJECTIVES**
- **DURATION**
- **TARGET AUDIENCE**
- **MANNER OF USE**

It details questions that should be asked about:

- **SIMULATION MODEL**
- **SOFTWARE ASPECTS**
- **DOCUMENTATION**
- **DESIGN PROVENANCE**

And explores:

- **CUSTOM DESIGN**
- **TUTORING OPTIONS**
- **COMMERCIAL ASPECTS**

It is designed to help the neophyte and, also, to ensure the experienced user does not overlook anything.

Development Objectives

The term development has been used rather than learning because the reasons for using simulations often address wider issues. Issues that include motivating and stimulating staff, assessing their business acumen, promoting the company or building the team. This wide range of objectives is illustrated in Figure 11.1 and discussed in detail in a separate chapter (**Learning & Simulation**).

- **EXPLORING KNOWLEDGE**
- **SKILLS PRACTICE**
- **MOTIVATIONAL NEEDS**
- **ASSESSMENT ASPECTS**
- **ENHANCING LEARNING**

Figure 11.01: Development Objectives

When setting objectives the interested parties must be considered: the manager participating, the manager's organisation, the tutor running the simulation, the tutor running the course and the organisation providing the training.

The objectives of these parties may interact and may include a "hidden agenda" that is not revealed explicitly (see the sidebar).

- Hidden Agenda -

I remember one client asking me to start a simulation on a Sunday night, run to 2:30am Monday morning and, then for the teams to prepare for a formal presentation at 8:00am on the Monday!

Learning Objectives

When deciding learning objectives it is important to remember that simulations are most effective at developing transformational comprehension rather than cerebral apprehension. That is to say they build on existing knowledge and provide a means of refreshing knowledge and integrating it into the manager's memory.

This means that it may be a mistake if a too advanced simulation is run. For instance, once I ran a strategic planning exercise designed for senior marketing managers with junior management. The result was disastrous. The junior managers did not have the background knowledge and experience to make strategic decisions.

Effectiveness, Efficiency & Consistency

Any learning process must meet the learning objectives effectively. However, this must be combined with efficiency. As discussed later, over complex simulations may deliver effective learning but at the expense of efficiency. Further, some learning processes, such as the "lecture" or CBT (computer based training) may be perceived as efficient but if they do not effectively deliver learning then the money is wasted.

The efficiency of a simulation is related to its original design objectives and purpose. Thus, for instance, a simulation designed for academic use may not provide efficient learning on a management course. Equally, a simulation designed for management short course use may not be efficient or effective on an academic programme. This is explained further in the sections on **Manner of Use** and **Documentation**.

Also, on management short courses all delegates should, consistently, reach similar learning levels. This contrasts with academic programmes where students are expected display learning over a spread of levels (from distinction to fail). This difference has implication in terms of simulation design and use. As suggested in the guide on **Tutoring Simulations**, on short courses, it is desirable for the tutor to manage learning. By providing suitable feedback the tutor supports and encourages weak teams and challenges strong ones. In contrast some, academic lecturers may leave their students "to make mistakes" and, arguing that, they should never interfere with the experiential learning process and student autonomy. Consequently, simulations designed for academic programmes may not have software functions designed to support the tutor.

Duration

The second factor and often the critical one, is duration. With the modal length of short courses being about a week, you can only budget a very limited amount of time to any session. Too little time is as bad as too much. Too little affects learning effectiveness and too much time affects learning efficiency.

Simulations, like all experiential learning, involve participants working on a problem. For learning to take place there must be time to reflect. If there is insufficient reflection time, learning will not occur. When the participants realise this they will become disaffected. Also, if the duration is too short the workload (cognitive pressure) becomes too great or is perceived as such. This leads to confusion and disaffection.

Equally, if the duration is overly long the simulation may be perceived as "too easy", participants feel that they are not being challenged and, consequentially, are wasting their time. To some extent workload can be increased by introducing optional (but preplanned) tasks.

Duration & Complexity

It is not surprising that duration correlates with model complexity, since, the more complex the model, the more thinking (cognitive processing) that must be done (Hall & Cox, 1994). What is surprising is the degree of correlation between duration and complexity. An investigation of a wide range of simulations with durations lasting from two hours to just over two days showed a linear relationship between the number of decisions and duration.

Simulations can be classified into three groups - simple (lasting two to four hours); intermediate (lasting up to a day) and complex (lasting more than a day). Provided all decisions are equally important, simple simulations involve making three to five decisions each period. Intermediate simulations involve making six to a dozen decisions each period and complex ones several dozen each period.

This classification assumes that the simulation is run in a single continuous session. If the simulation is spread over several weeks, interspersed with other sessions, participants have time to reflect (consciously or subconsciously). This means that the scheduled time represents only part of the time applied to the simulation. So, more complex simulations than suggested by the "rule" are needed.

Where the simulation involves making a range of decisions of differing importance (as is true for functional simulations) the empirical rule will not be applicable. Ultimately, it is important to check that the simulation has actually been run in the time suggested.

Target Audience

As part of the process you must consider the target audience. This does not just mean the participants' job functions but include their prior knowledge and experience.

From a supplier's viewpoint there are several concerns. First, there are considerable differences between organisations. So, for instance, a middle manager from a large, multinational is likely to have had considerable management training. In contrast, a middle manager from a small to medium sized company might have had little or no formal management training. Thus, for the first organisation, a complex simulation addressing strategic issues may be appropriate. For the second organisation, an appreciation level simulation may be appropriate.

Second, in my experience, course designers often over estimate the capabilities of participants. Even if the simulation is to "stretch" participants it may be better to err on the side of simplicity.

- Thought -

Why is it that some course directors feel that their delegates will be the best and most knowledgeable in the whole wide world and then are surprised when the chosen simulation is too complex!

If the group is better than expected, time pressures can be increased and additional tasks added to the simulation (see the **Supplementary Tasks Appendix**).

When evaluating the target audience, consider the mix of experience, corporate culture and maturity. Experience mix is two-dimensional. First, there is cross-functional experience. Second, there is the mix of management levels. The mix of functional experience may suggest gaps, especially in basic financial knowledge. The mix of management levels produces interesting behavioural problems (especially if the junior

management is better trained than senior management). If there are just a few senior managers you might consider using them as a coaching resource.

Corporate culture and maturity can be problematical. Having worked in the computer industry and with an engineering degree it seems to me these groups illustrate such problems. Some groups of, usually young, managers are "prima donnas" (I especially avoid MBAs). Some groups take a simplistic view of the world and attempt to "break the model" rather than run a simulated business.

Besides the learners, you will need to consider who will be tutoring the business simulation and this is explored later.

Manner of Use

The manner of use (Figure 11.02) is described in detail in the guide entitled **Ways of Using Business Simulations.**

- **COURSE FINALE**
- **COURSE STARTER**
- **COURSE THEME**
- **REINFORCE A TOPIC**
- **AS A BREAK**
- **CONFERENCE GAME**
- **STAND ALONE**
- **ASSESSMENT/DEVELOPMENT CENTRES**
- **SPARE TIME LEARNING**
- **GRADUATE RECRUITING**
- **PROMOTIONAL CONTEST**

Figure 11.02: Ways of using simulations.

The manner of use affects both the complexities of the simulation and logistics. So, for instance, a simulation designed for academic use where it is used once a week over a term or semester may not be suitable if you wish to use it on a single session on a course.

The Simulation Model

A key element of the choice of simulation is the simulation model - its realism & complexity, the business modelled and the "calibration" of the model.

However, before discussing these aspects, this section briefly describes the simulation model and how it differs from models used for corporate planning and budgeting. The models used by the simulation can be divided into two groups - Financial/Corporate and Economic.

Financial/Corporate Models

These represent the tangible aspects of the business. They are similar to those used when budgeting and planning. They do the calculations needed to prepare the financial accounts (Profit & Loss and Balance Sheet) and calculate materials flow, cash flow etc.

The financial/corporate models require no further explanation, since many, perhaps most managers have had experience building such models using spreadsheets.

One aspect that deserves attention is financial reconciliations. Most important is the Balance Sheet and whether it balances! (Experience suggests that, the first thing an accountant does, when participating in a simulation, is to spend a long time check to see if the Balance Sheet balances!) It helps that if, besides the Profit & Loss Account and Balance Sheet, the simulator produces a Cash Flow Statement and has a set of work sheets allowing manual reconciliations.

Economic Models

These represent the intangible aspects of the business. Depending on the simulation, they model market responses, stochastic elements, inflation, operating efficiencies, etc. They utilise economic and management theory and models.

The market model translates marketing decisions such as price and advertising into sales. Because of the complex nature of this response, it helps if the tutor's manual explains the responses. Also, it may help if the simulation software reveals these responses to the tutor so he or she can identify problem areas.

Some simulators have stochastic (random) elements. Randomness makes it more difficult for participants to perceive relationships between decisions and results. Also randomness introduces a degree of "luck". For interactive simulations, the interaction of team decisions, usually, makes it difficult enough for teams to perceive relationships. However, for functional simulations, especially non-interactive ones involving production processes, managing uncertainty is a necessary element. So, these simulations are, usually, stochastic.

Although part of the real world, inflation makes it more difficult for participants to perceive cause and effect relationships. Also, constantly changing costs adds to a team's workload. Often, learning is just as effective with a simulation with no inflation as one with inflation. An exception to this is where operational control and budgeting is an issue (as is true for tactical management). If inflation, or for that matter, currency variation is involved then a report differentiating its effect can help separate the results of team actions from cost or currency drift.

Complexity & Realism

A complex simulation model has a certain elegance and its development is an exciting intellectual (perhaps artistic) challenge. Unfortunately, the provision of an overly complex simulation model may be counter productive.

The appropriate level of model complexity depends on:

- **DURATION**
- **FOCUS**
- **DYNAMICS**

Duration

This has been described and discussed earlier in the context of complexity.

Focus

The link between duration and complexity means that unless the simulation focuses on the development objectives participants will waste time handling the superfluous issues. So, the features of the simulation model must match and support the desired learning outcomes. For instance, a strategy level simulation might model multiple market segments (to explore portfolio and segmentation issues) yet have a very basic production model (where operating decisions occur automatically). In contrast, a tactical level simulation might have a simple marketing model but a complex production one.

Another focus is realism. Realism parallels complexity and many use this argument to justify the addition of extra features to the model. Certainly, a fundamental level of realism is necessary but perhaps the main benefit of a model is its ability to clarify though simplification and focus.

For example, an aerial photograph is the most real model of geography. Yet, a road map, with its topographic and chromatic simplifications and distortions is far superior to the aerial photograph for journey planning.

- Thought -

Which is best for journey planning? A road map or an aerial photograph? And which is the most realistic?

The third focus is towards learning rather than corporate planning. This is not to say that corporate modelling skills are not applicable. They are, but must be surrogated to learning needs.

Over emphasis on corporate modelling and realism may be at the expense of learning and may show the designer has not recognised the difference from corporate planning use and the needs of management development.

Dynamics

A well-designed simulation model is not a static entity. It must provide a changing challenge over the learning session (Hall & Cox, 1993). At the start of the simulation, workload is high as participants become familiar with the simulation, form their team, attempt to understand the marketplace and foresee competitive actions. As time passes understanding builds and although decision frequency is usually increased, the simulation should provide additional challenges. These might be liquidity difficulties, production capacity constraints, new market opportunities etc. Beyond increasing time pressure and new challenges, the tutor may need to provide additional feedback. As described in the section on support the simulation may furnish suitable materials.

The Business Modelled

When choosing a simulation you must consider how closely it replicates the business(es) of the participants. There are several possibilities:

- **A REPLICA OF THE BUSINESS**
- **A REFLECTION OF THE INDUSTRY**
- **A GENERIC BUSINESS**

The Replica Business

At first glance, an accurate replica seems the ideal solution. However, there are several issues:

- **COMPLEXITY**
- **DURATION**
- **COST**
- **PERCEPTIONS**
- **LEARNING**

Complexity & Duration: A really accurate model is complex. This complexity means that the simulation may take several days to run. Further, it will take considerable effort to develop. Not only will modelling take time but the development will require lengthy consultation with senior management and considerable research.

Cost: A complex replica is costly to create, become familiar with and run. Also, since the focus is on modelling the business, the replica may be more useful as a planning aid than to providing learning.

Perceptions: Despite the complexity, a simulation can never, completely, replicate the business. This is especially true for the behaviour of markets and customers. Also, some participants may come to the simulation with preconceived views of their business. If the simulation does not reinforce these views, even if these views are wrong, the model will be perceived as inaccurate and the session useless.

Learning: Even if these problems are overcome, the business situation modelled must be adjusted to emphasise and focus on development objectives. Once, I developed a simulation that replicated the operation of a business that bid for and then designed systems for clients. A situation that is common in large engineering, construction, aerospace and computer service companies. Unfortunately, a characteristic of a contract-based business is that it is inherently difficult to manage. Companies swing between too much business and too little business. This coupled with very high fixed costs, means that profit and cash flow swings are worse. Because of this, this simulation was only suitable for senior management. Also, it had to be double manned with one tutor adjusting the flow of possible contracts to help smooth the swings.

The Generic Business

At the other extreme, the simulation is chosen where the model is totally different from the participants' business and may even represent a different industry.

Such a simulation may be useful, if the simulation is:

- **TO CHALLENGE MANAGEMENT**
- **TO PROVIDE ROLE REVERSAL**
- **USED BY A MIX OF MANAGERS**
- **THE ONLY ONE TO MEET OBJECTIVES**

In these turbulent, ambiguous, and rapidly changing times, the reason for using a simulation can include intellectually challenging management - forcing them to step outside their own business. Using a simulation different from the "cosy" business they know does this. But, it is important to explicitly explain this objective to the participants.

Often it is useful to place managers in the roles of their customers or their suppliers. For instance, it may be useful to have a group of bankers being placed in the roles of the management of a small business (especially, if managers of small businesses are invited to role-play bankers!)

Where the simulation is used on a course where participants come from a variety of businesses the choice of business modelled is less important. Although it should not be too specialised and so not relate to the participants' experience and perceived needs. In this situation, a generic manufacturing business simulation is often used. However, there are other options. For example, a major management school required a simulation to explore marketing concepts and strategy. Also, they wanted a service based business rather than a manufacturing one. To provide sufficient detail and realism, a specific business was modelled. This was a hotel. This was chosen because it was felt that the course participants would have (as customers) experience of and views about hotel marketing.

When choosing a simulation, development objectives should be matched with the simulation. Ideally, this match should, also, be with the participants' industry. However, you may be faced between choosing a long, complex simulation related to the participant's industry or one divorced from the industry but precisely meeting the learning objectives. This is a difficult choice. The complexity and lack of focus of the industry specific simulation may limit learning or require an overly long session. On the other hand, participants may not see the relevance of the other simulation. Experience suggests that industry focus is more important for junior management than it is for senior management. In both cases, if the non-industry simulation is used, the reasons for its choice and scenario should be explained to the group.

Industry Reflection

Here the model is not an exact replica of the participants' business rather it reflects the general characteristics and issues of their industry. So, the marketing environment,

financial structure and terminology are similar too but do not fully copy the participants' business.

The market model should replicate the markets' structures (selling direct, through distributors, etc.), buying patterns (repeat purchase, durables, consumables, etc.), etc.

The financial model should be similar in terms of fixed & variable cost relationships, working capital & fixed assets relationships, price margins etc.

Terminology is, perhaps, the most important aspect. Ensuring that the financial and business terms used in the simulation are similar to those used by the participants is a major step. With many simulations it is relatively easy to change the simulator's database to do this. Also, if the participants' brief is available on disc it is easy to change this.

Provided the marketing and financial structures are similar to the participants' business, just changing the terminology can be a quick, cheap and effective method of tailoring. For instance, once, a generic retail simulation was changed into one for a distribution company. This took less than half a day and only involved changing terminology (neither the model nor the master data were changed). Yet, on running, one participant, a Managing Director, congratulated us on realism. He opined that we must have spent a long time with their finance department tailoring the simulation!

Calibration

A problem in using simulations is the way workload varies during them. Calibration provides one way of maintaining workload. It does this by progressively increasing the work during the simulation. Thus, as participants become organised, learn about their business, the market, the competitors and each other's skills, the simulator introduces additional work.

Those simulations that are calibrated to increase workload usually do it in one or a combination of these ways:

- **ECONOMIC PRESSURE**
- **EXPANDING RANGE OF DECISIONS**
- **EXPANDING THE INFORMATION PROVIDED**
- **NEW FACTORS**
- **SUPPLEMENTARY TASKS**

Economic Pressure involves making it progressively more difficult to manage the simulated business. An example, is a simulation where, initially, the business is profitable and cash rich. However, latent demand in the industry causes expansion. This expansion required considerable investment in fixed assets and working capital, causing cash shortages just at the same time as competitive pressure reduces profitability and operating cash flow.

Another example, is a production management simulation. Here the in-built, seasonal pattern means that, initially, scheduling was relatively simple. However, eventually, the seasonal peak, coupled with capacity and liquidity restrictions, means that scheduling has to be very exact. So, initially, participants' can "get it wrong" while discovering bottlenecks, problem machines, suppliers, etc. However, eventually, they have to get a near perfect schedule.

Although economic pressure is built into the simulator, it may be necessary for the tutor to adjust it. The easiest way is to change the underlying market size. Increasing the market size (especially for high fixed cost businesses) is to increase demand and thus profits and so reduce pressure. Reducing market size increases pressure and, because of competitive responses, usually reduces profitability significantly. With a well-calibrated

simulation, tutor interaction is usually not needed. Even so, the ability to change market size is a useful feature.

Finally, an important implication of economic calibration is the linking of the data to the model. The designer based on multiple runs of the simulator will have done this. Runs that investigate the dynamics of the simulator and that are used to adjust economic patterns. This means that, if you have access to the simulator's central database, you should consider carefully before changing it. (In software design terms this linking of data and algorithms is an object-oriented paradigm.)

Expanding Range of Decisions involves either more of the same or additional decisions being made as the simulation progresses. For example, a simulation designed to explore strategic issues starts with the company serving one or two markets. As the simulation progressed, the teams expand into up to eight markets. As a result, initially, each team had to make four to seven decisions. But, eventually, they could be making more than thirty decisions each period.

In another instance, the range of decisions expands as a few, general decisions are separated into a series of sub-decisions. So, for instance, marketing might start as a total expenditure. Later, separate decisions could be made for advertising, sales force, promotion etc.

Expanding the Information Provided involves providing additional reports as the simulation progresses. These reports are designed to cause the teams to discuss and reassess their policies and strategies.

The new report might just be a table summarising trading history. By showing results side by side, the teams are better able to see trends and any distortions. Another report might show profit contribution by market or product. Doing this encourages teams to analysis how markets or products contribute to the business portfolio.

An example of new reports, is a simulation where an objective is to explore team working. After four simulated periods the computer produces reports that show individual success!

Provided these reports are available, it is often possible for the tutor to decide whether to provide them and which teams need or can handle the information. So he or she can tailor learning.

New Factors involves introducing changes to the basic simulation. In contrast to economic pressure (where the change is smooth) these new factors represent a "step" change. The changes may be to the data and the model.

An example of data and model changes is a simple simulation involving launching a new product. Initially this is into a market with no direct competition. Later, just when the team is established, competition enters the market necessitating a complete review of the situation and stimulating though and discussion.

Supplementary Tasks are optional for example requiring the groups to prepare a written plan or supply forecasts for key results with their decision. Examples of supplementary tasks are provided in a separate guide. (Further examples are shown in an appendix.)

Software Aspects

When choosing a simulator several aspects of software design and methodology must be considered:

- **PROCESSING TIME**
- **DECISION CHECKING**
- **PRINTER FAULT HANDLING**
- **EASY RERUNNING**

Besides being needed for efficient and "hassle free" use, these show software development expertise. If the software lacks these basic features, this shows a lack of software expertise that may extend to other areas of the simulator (such as the model design, testing, calibration etc.).

Processing Time

A critical aspect of simulations used on short courses is that of processing speed. On most short courses, simulations are used in a single session rather than spread over several sessions. This means that, while decisions are being processed, the business simulated and results printed, participants will be, waiting idly (and in anticipation) for their results. With some simulations, where processing takes more than half an hour, this is a problem. (If it takes much more than five minutes it can be a problem!)

Bottlenecks are well known in Data Processing and there are some common solutions. For simulations, bottlenecks occur in several areas:

- **COMPUTATIONAL SPEED**
- **DATA ENTRY**
- **PRINTING SPEED**
- **INTERFACE DESIGN**

Computational Speed: As more and more powerful microprocessors and faster and faster hard discs arrive computational time is not likely to be a problem. Although there are two possible problems: the use of spreadsheets and the use of interpreters.

Spreadsheets are designed for business planning may not offer the features and functions required for a simulation. Specifically, spreadsheets are designed to ease model development rather than model use. So, although they are useful for prototyping simulations, they may not be able to process decisions sufficiently quickly, print the reports needed or automatically back-up data. Also, they may have superfluous software functions (that tend to confuse the user).

Simulations written in a "high level language" can either be compiled into machine code or "interpreted". This process is similar to the translation of human language. Interpretation is similar to simultaneous translation where words are translated one at a time. For compiled programs this translation work is done beforehand and the program optimised. So, interpreted programs are slower than the compiled ones. (Although, unless the model is very complex, modern microcomputers are likely to be fast enough.)

Data Entry: For simulations where decisions are entered by the tutor this can be a problem. It is especially true for interactive simulations where all the teams' data must be entered at synchronously. It is less critical if teams can be persuaded to submit their own decisions on a floppy disc or via a network or where participants make direct use of the simulator.

The design of the software can help in several ways:

- **only enter data that change**
- **enter teams in any order**
- **entry checks**

Only enter changes: Usually, teams change only some decisions, so the number of key strokes can be reduced if the previous decision are held on file and used as a template for the new ones.

Enter in any order: Some teams will submit their decisions early. If decisions can be entered in any order, these "early" decisions can be entered while awaiting the other teams. This saves time. However, if the software insists on a particular order, all decisions must be received before entry. Also, if a team does not submit decisions (by the

deadline), it helps if their previous decisions can be used instead. (Parenthetically, the threat of doing this is an effective motivator!)

Entry checks: The pressure on entry speed causes errors. These can be reduced through comprehensive software checking (see Decision Checking), regular on-screen confirmation and decision printing and checking before simulation. Pre-emptively catching errors before processing is quicker than rerunning. Although, as a last resort, the ability to rerun is necessary.

Printing Speed can be increased by

- **using a fast printer**
- **printing during processing**
- **printing in stages**

Using a fast printer only speeds printing if the printer is reliable. You must consider reliability, portability and, possibly, the ability to print multiple copies. A very fast printer may be prone to jam, consequently any speed gains are lost (because it is necessary to reprint and, possibly, rerun). When running in hotels or at clients, especially if travelling by air, portability may be the deciding factor.

Because of these issues, software features such as printing during processing and printing in stages can be important.

Printing during processing can save time (especially for complex simulations). Here, as processing occurs, reports are printed as the data for them is computed. Provided the printer has a "buffer" (most do), printing is done in parallel with processing. However, it is absolutely essential that the printer is reliable (see **Printer Problems**). If the printer is not reliable and is prone to jam, processing may have to be aborted forcing a rerun. So, the software should provide options for printing during or after processing. (So, with a reliable printer, printing is done during processing. With an unreliable printer, printing is done after processing and after the results have been, safely, stored on disc.)

Printing in stages allows some results to be provided to teams quickly, with the main results provided later. By doing this, teams work on the preliminary results while awaiting the full ones (but this may not be possible with some simulations).

Interface design reflects the purpose of the software. The interface needed for simulations that are run by the tutor is different from those where the participants make direct use of the simulator. In both cases, the simulator is not used in the same way as office software (Hall, 1995b).

For simulations where the tutor enters decisions, speed is vital and there are only a few, defined processing sequences. Flexibility and switching between applications are not important.

It is quite possible, that a character-based interface is faster than a graphic one (using a mouse). This is especially true if the person using the simulator has typing skills.

- Thought -

One wonders that, if one were meant to play with a mouse it would have been better to be born a cat. After all, sleeping all day lying in the sun and having one's tummy rubbed has certain attractions.

Where the participants use the microcomputer directly themselves, software learning time must be short. Unlike software used regularly, the direct use simulator is only used once by the participant. So, because of duration constraints and in the interest of learning efficiency, the interface must be simple. Also, the need for simplicity means that the software must have limited but focused functionality.

Decision Checking

As described above, the rapid and accurate entry of decisions is important and software can help in two ways:

- **CHARACTER CHECKING**
- **RANGE CHECKING**
- **SOPHISTRY CHECKING**

The first two are established computing techniques and, if the simulation does not use them, you must seriously question software design expertise.

Character Checking involves checking keys as they are pressed and filtering out inappropriate characters.

If the software expects a number to be entered, only the number keys are enabled and the others disabled. (Also, if the entry is a decimal number, the software enables the decimal point but, only until it has been pressed once.

- Thought -

When evaluating a simulator try entering the letter Oh rather than the number zero. Try multiple decimal points, minuses, etc. - does the software collapse in disarray or, worse, does it accept your entry and try to process it!

Range Checking involves checking to see if the decision entered falls within a defined range. This may be done at two levels. First, the software may reject decisions that are totally unreasonable and would cause problems with the model (such as zero or negative prices).

The software may have a second, narrower check that warns of problems but, after confirmation, accepts the entry. This allows for radical strategies but warns of them.

- Thought -

When evaluating a simulation, try some wild decisions (because if you don't the participants will) - does the software remark on these.

Sophistry Checking is a phrase I use to indicate that the simulator checks the reasonableness of decisions against the current business situation and basic business principles. So, for instance, if the company is over borrowed (liquidity problems) then it would not be sensible for it to invest heavily in capital. If they attempt to do so, the simulation warns of this.

Printer Problem Handling

The most common problems encountered while running a simulator are those with the printer:

- **PRINTER DESELECTED**
- **PAPER JAM**
- **PAPER OUT**
- **WRONG CONFIGURATION**

Printer Deselected occurs when the select/deselect button has been pressed taking it "off-line". Deselecting is necessary on most printers to allow a page to be fed from the printer. Unfortunately, after deselecting and pressing the form feed button, the select/deselect button is not pressed a second time. When the software attempts to print, an error is encountered.

Poorly designed software will abort and force a complete rerun (including data entry). If this is not trapped and recoverable you should question the designer's skills and experience. As a minimum, the software must advise of the problem and allow for correction.

- Thought -

When evaluating a simulation, try deselecting the printer or running it without paper - does the software allow you to correct and continue and how long does this take.

Two additional features can be useful. First, the software should provide the option of completing simulation and save the report data to disc file before printing reports. If there are printer problems, the software can be stopped and, on restarting the reports printed without having to rerun. Second, the deselecting problem occurs when page feeding, it helps if this is done using the software (and so eliminate the need to touch the printer!)

Paper Jamming can occur if the printer paper is wrongly loaded, if the paper feed path is obstructed or, with some (perhaps most) printers, if multi-part paper is used. Again the solution is the ability of the software to report on the problem and allow correction before resuming printing. As some printout may be damaged, the ability to reprint the report is necessary.

Paper Out can occur and requires the same measures as for a printer jam.

Wrong Configuration may occur when the simulator is used for the first time (most often with a laser printer or on a network). Usually it is not possible for the software to correct this. It will be necessary to exit the software and reconfigure (perhaps, helped by a technical expert). Happily, this problem is rare.

- Thought -

If you are using the simulation on a strange computer and printer, check compatibility well before hand at a time when a technical expert is available. (I accept that, to some, all computers are strange (and technical experts are even stranger)).

Also, if the software supports reprinting after rerunning (see Deselecting) all is not lost!

Rerunning

The ability to rerun is key. At sometime there will be an entry error, printer problems, hardware problems or, even, decisions that are beyond the scope of the model. (It is standard data processing practice to be able to rerun.)

The software should allow recovery to the previous period. To do this the software keeps a copy of the previous data. If this backup is not automatic, avoid the simulation.

- Thought -

When evaluating a simulator, try switching off or rebooting the computer during the trial. How loud does the sales person scream and how long does it take to recover.

Large discs allow even greater backup. All past data can be "journalised" (automatically saved for recovery). If this is done, then you can rerun from any period. When this is done, the data (and the decisions) for the period selected are reloaded. If the decisions have been saved, you only have to alter some decisions (rather than re-enter them all).

If the back-up process is not automatic, the risk is that the tutor will forget to back-up (usually just when it is needed). Rerunning a single period is time consuming, rerunning several, especially where the decisions must be manually re-entered is unacceptable.

Documentation

Typically simulation documentation consists of:

- **BRIEFING SLIDES**
- **PARTICIPANT'S BRIEF**
- **TUTOR'S MANUAL**
- **SUPPLEMENTARY TASKS**

Briefing Slides

A good starting point when evaluating whether a business simulation is right for you is to look at the briefing slides. These should provide a useful overview of the simulation, the task, the business managed, the decisions and results. As learners are usually enthused about the activity and may become bored with a long briefing, a short briefing is important.

Participant's Brief

Participant's briefs may be short, providing only basic information; or extensive, providing additional tasks and readings. To an extent the reason for this difference is philosophical. Short briefing documents are likely to have been designed for manager short course use. Here, the shortness of the briefing recognises time pressures and that many managers do not read long treatises diligently.

The longer participant manuals may have been designed for full time academic courses. Here, students have "spare" time between lessons for familiarisation and the nature of pedagogic teaching means that there is pressure on the students to be diligent. Also, publishers of academic simulations often receive a large part of their revenue from the sale of participant manuals. Because of this, a long and weighty tome commands a greater price, increased royalties and is perceived as pedagogically more valuable.

A short participant's brief must provide basic information and assumes that the participants are sufficiently experienced to interpret the data. If additional explanation is needed, the tutor supplies it (from the tutor's manual and experience).

Depending on development objectives, participant knowledge and experience, the brief can always be supplemented by additional tasks (see **Supplementary Tasks**).

The long brief attempts to cover all eventualities. This is appropriate where tutoring is to be minimal. Besides academic use, long briefs are fitting for distance learning programmes where participants work on the simulation in their own time and submit decisions by mail.

Tutor's Manual

The tutor or administrator's manual serves several purposes and provides information on the software and the simulation and, perhaps, experiences from actual use and tutoring tips.

The scope of the tutor's manual depends on the complexity of the simulation. For simple simulations it may be a few pages. For complex ones it might run to many pages.

Like the participant's manual, the tutor's manual is a compromise between brevity and completeness. A brief manual may be read but a long one, providing comprehensive instructions, may not. (The Tutor’s Manual should be supplemented and supported by on-line, context sensitive support in the simulator.)

Supplementary Tasks

For very short simulations these may not be appropriate. However, for longer, more complex ones, they allow the simulation to be tailored to differing developmental objectives. Examples of these are listed (Figure 11.03) and detailed separately in the **Supplementary Tasks** brief.

- **BOARD PRESENTATION**
- **KEY RESULTS FORECASTS**
- **MANAGEMENT BRIEFING**
- **BUSINESS PLAN**
- **BRIEF FOR VISITORS**
- **ORGANISATIONAL STRUCTURE**
- **SIMULATION NEWSPAPER**
- **PLANNING WORKSHEETS**
- **PLANNING SPREAD SHEETS**

Figure 11.03: Supplementary Tasks

Design Provenance

The term provenance is used in the art world to provide assurance that the artefact is as described. Here, it is used to explore the key issues that suggest the track record of the simulation and its developer. These are:

- **Developer's Background**
- **Use & Usage**
- **Tutor Support**

Developer's Background

As with many technological products in the early stages of their "industry life-cycle" there are a profusion of suppliers with a wide range of skills and experience in the key areas of:

- **SIMULATION DESIGN**
- **ACTUAL TRAINING USE**
- **MANAGEMENT DEVELOPMENT**

Suppliers of simulations range from the academic who, in his or her spare time, has developed a single simulation to the professional organisation that has developed many simulations over many years for management development. This is not to say that, a single simulation developed by an academic will not meet management development objectives. It may, especially if the simulation has been used extensively and the academic has business and, perhaps, line management experience. But, the risk is higher.

Equal to design experience, is experience in running simulations on actual management courses. Simulations are not static. Only experience running them allows their "dynamics" to be checked. Does the simulation model respond sensibly? Is the response stable? Are the interactions between decisions appropriate? Is model complexity appropriate to the learning objectives? Do the results provide sufficient information for participants to "tease out" the cause and effect relationship? Like the design of a high performance motorcar, a simulation must be "tuned". So, just as a car is tested on the track a simulation is tested on courses. Because of this, the developer must have had significant experience both in developing simulations and in using them.

Use And Usage

The discussion so far has been about the designer rather than about a specific simulation. Use and usage focuses on specifics. Use refers to "Manner of Use" for which the simulation was designed. These uses are described in more detail in the chapter **Ways of Using Business Simulations**. Usage refers to the extent to which (number of times) the simulation has been used.

The concern is whether the simulation has been designed for the use envisaged (use) and whether the design has been successful run in this manner (usage). For instance, the design specification of a series of simulations required that they could be run in half a

day. This demands a reasonably simple model. More importantly, the decision entry and simulation cycle had to be very short and the "bottle-necks" of decision entry and printing minimised.

Tutor Support

Since the mid-1990s business simulations should have been developed or revised to include a *Tutor Support System* (Hall, 1994). A Tutor Support System enables the trainer to facilitate, manage and ensure learning. Besides providing reports for the learners showing the results of their decisions, the Tutor Support System provides additionally reports especially for the trainer to allow him or her to answer questions rapidly and authoritatively, identify which learners need coaching and challenging and provide information to help the review at the end of the simulation.

Custom Design

The risks associated with the choice of a simulation are greatest where no suitable simulation exists and it is necessary to commission the custom design of a new simulation. This risk can be mitigated in two ways - by using a designer with considerable experience and by basing the new simulation an existing one.

Design Experience

A simulation is more than just a model. The novice designer usually does not recognise this. Nor will he or she recognise the problems associated with the design of robust simulation software. Without experience, superfluous complexity may be built into the model, it may be inadequately robust and calibration and testing may be deficient.

Robustness is important. Participants do not always make logical or reasonable decisions. There are classic examples of teams increasing prices a million-fold and still selling a unit and so producing massive profits. Most problems are less obvious. If a problem occurs with your personal spreadsheet model it is not "broadcast" to others! You can lock the office door and modify the spreadsheet in private. If the simulation collapses during a course, you are faced with placating perhaps several dozen senior managers. Managers who have been fully involved in the activity and excited at their success! Even if a "work around" is possible (and it often is not), dissonance will have been created and there will be less trust in the experience. Teams may become disaffected and, as a result, they perceive that the session is a waste of time.

A very experienced designer and user of simulations suggests *"Many people design one simulation but very few design more than one"*. He was implying that, many misjudge the difficulty of designing a good simulation. Paternal feelings and dissonance reduction means that the sole *"offspring"* (simulation) is used and, perhaps, *"improved"* but, further designs are not attempted.

Modification of Existing Simulation

It is often possible to modify an existing simulation to meet development objectives. In increasing degree of difficulty, this involves:

- **CHANGING TERMINOLOGY**
- **CHANGING PARAMETERS**
- **MODIFYING MODELS**

Changing Terminology involves changing the text associated with the simulation. This may involve changing financial terminology, the names of products and decisions or the participant's brief.

Provided the simulation software holds this textual data in a data file these changes are quick and simple and often can be done by the purchaser. However, if the text is

embedded in the software the changes are not so straightforward and may not even be possible.

Changing Parameters involves changing the parameters that drive the simulation model. If the data is held in a data file or the simulator provides this option this may seem a simple, do-it-yourself option. However, if you do make these changes you should run the simulator several times with dummy data. The reason for this is that, if you change these parameters, the "calibration" of the simulation will change. As a result the simulator may behave in unexpected ways.

So, changing parameters is more difficult and much more expensive than just changing terminology. The safest and cheapest option may be to leave these changes to the simulation designer as he or she should have a clear understanding of dynamics and have extensive test data.

Modifying Models involves removing or changing existing models or adding new ones.

Removing a model may be appropriate where you wish to simplify the simulation and the removal disables a decision area and the associated results. Often this can be done without changing the software. All that is needed is to alter the decision form and not allow changes to the disabled decisions.

Changing models may be appropriate where the simulation meets primary development objectives but the industry, market, operational or financial aspects are wrong. For example, the Casino Challenge was derived from the Service Challenge by partially changing the marketplace models (but leaving the other models intact).

Adding models allow additional development objectives to be met using the basic simulation. For instance, RESERVE was developed from a simulation called Management Challenge. The need was for engineers and scientists to understand the link between R & D and commercial success. The additional models impacted the effect of R & D on product performance, quality (cost & customer need) and material and process costs. However, when adding models, you must consider how they link to learning objectives and, because of the additional complexity, how they lengthen the simulation. So, although Management Experience lasts a day, RESERVE lasts a day and a half.

If the simulation designer uses "Object Oriented" and structured programming methods modifying models may be relatively inexpensive. If not, it may be better and cheaper to design a new simulation from scratch.

(Object orientation involves building the software as a series of blocks of reusable code. Each program is an assembly of separate tried and tested components. If this approach is used the new simulation will consist mainly of existing components and a few new ones. As the existing components already exist and have been tested their quality and reliability are assured and costs are minimised. The new components must be developed and tested as will the complete assembly. But, this testing will be focused and develop work will be minimised.)

Creating a New Simulation

This is the most expensive option but is the only viable one if no suitable simulation exists or can be modified. The design specification is likely to involve the following steps:

1. **The definition of the knowledge to be explored** and this defines the business to be modelled and the scope and focus of the models.
2. **The skills to be practised** must be defined and this refines the definition of models and determines what (if any) additional activities (such as negotiations or budgeting) must be incorporated.

3. **The required prior knowledge and experience** must be defined and this sets the design in this context and the extent to which it utilises and needs to link to and reinforce this knowledge and experience.
4. **The balance between cognitive learning and fun** must be defined and this defines the difficulty of the simulation and the extent to which the participants have to struggle.
5. **The measures of assessment and attainment** must be defined and this defines the reports (team commentaries) that document progress and allow for tutor guidance during and after the simulation.
6. **The time that can be budget to the activity** must be defined and this defines the simulation's complexity and the number of decisions that can be made each period. (Although well down the list, my experience is that this is often at the top of the list.)
7. **The way it is to be used** (as a course finale, course theme, stand-alone, etc.) must be defined as this influences logistics and the time available for participants to reflect. From this the assessment of simulation complexity, documentation, support needs etc. will be revised.

Having defined the requirements the next stage is creating the software - computer and documentation, calibrating and testing the simulation. A professional simulation designer is likely to have a library of models and, perhaps, use a simulator "shell".

Software architecture is an esoteric subject not appropriate to this guide. However, as shown in the side bar, a simulation like a sandwich comprises two parts - the model and the shell. The shell comprises the user interface, the data entry routines, the database manager, the report generator and the help system.

As, typically, the model only accounts for ten-percent of the simulator, using a pre-programmed shell can reduce development time by 80 percent or more.

- Sandwich Metaphor -

Simulators are rather like a sandwich - the filling (the exciting bit) equates to the model and the slices of bread to the simulator shell - the part, like the bread, that encompasses and manages the model.

Consider the cost of building a sandwich if every time you wished to make one you had to mix the dough and bake the bread. Sliced bread eliminates that need and, likewise a simulator shell speeds construction, saves cost and is more reliable.

Design Methodology and Structure

The software design of business simulations presents particular problems in terms of design methodology (Hall, 2005) and structure (Hall, 2008).

Classic software design is a rigorous structured methodology that has been replaced with agile methodologies. Unfortunately, business simulation design requires a combination of the two – rigour and structure to ensure timely completion and agility to handle the *creative* aspects of design. To ensure the quality of design, the designer should use a recognised design methodology that addresses the conflicting issues of rigour and creativity.

Simulation structure impacts the effectiveness of learning and extends beyond the simulation model to include interactions (decisions and results), how the simulation evolves and how learning and engagement are embedded..

Comparing the Options

The design time implications of the different custom design options are shown in the table.

Design Option	Development Time
Change Terminology	A day or less
Change Parameters	Several days to several weeks
Modify Models	Several weeks to several months
Create a Simple Simulation	A month or so
Create a Complex Simulation	Several months

Table 1: Indicative Design Time

Tutoring Options

Most simulations are designed for the average trainer. Others may only be available on a fully tutored basis and, even those designed for the average trainer are usually available on a fully tutored basis.

This section discusses whether you should run the simulation yourself or whether you should have it run for you by a specialist.

The choice between self-tutored or using a specialist is a balance between the cost of becoming familiar with the simulation and the additional cost of using an external consultant.

Also you have to consider the difference in risk between using in-house staff and the experience and knowledge of the external consultant. These depend on the following:

- **BUSINESS KNOWLEDGE & EXPERIENCE**
- **GETTING UP TO SPEED**
- **SIMULATION COMPLEXITY**
- **SIMULATION SCOPE**
- **NUMBER OF TEAMS**
- **LOGISTICS**
- **FREQUENCY OF USE**
- **COMPUTER LITERACY**

Business Knowledge & Experience

The person who tutor's a business simulation requires a different knowledge set from an instructor and, perhaps, the university professor. First, the person running the simulation needs to be a competent coach and manager of learning rather than a good presenter or instructor. Second, the person running the simulation needs to be able to link learning from the simulation to the real world. **?????**

Getting up to Speed

Before running any simulation it is vital that the tutor is familiar with the learning issues, the simulation and the software. This preparation may last as little an hour for a simple simulation to several days for a complex one. If this time is not available, an external, specialist tutor should be used.

Simulation Complexity

Except complex simulations (those with a dozen or more decisions lasting longer than a day), the average trainer will not have to spend much time preparing as the issues raised by the simulation will be simple. For complex simulations, using a specialist is attractive. An alternative, where the simulation is used frequently, is initially to run the simulation with the expert. For the next run, where you are running it on your own, ensure that the expert can be phoned. If the expert is not available, a trial run with unimportant participants (such as a local college's students or full time MBAs) is advised. This trial run can even be positioned as corporate public relations!

Simulation Scope
The management issues and knowledge addressed by simulations are often wide ranging and under the control of the participants. This means that the range of questions asked by participants can be daunting. As the simulation becomes more complex the scope increases and you have the choice of using a second tutor with specialist knowledge or relying on the external consult being a generalist.

Number of Teams
A very experienced simulation tutor can run simulations with up to six teams and, even the novice tutor should be able to handle three or four teams. For the less experienced tutor, for more than four teams, it may be economically attractive to buy-in expert tuition rather than double or even triple man.

Logistics
Coupled with the number of teams is the question of logistics. If the syndicate rooms are clustered closely around the control centre tutoring is easier. If they are spread as often happens in a hotel, then several tutors will be required. If these are external consultants the costs will be high. (Although, if the logistics necessitate several tutors, it provides an opportunity for in-company staff to learn from the external consultant. Provided the in-company staff do not hide just when the external consultant needs their help.)

Frequency of Use
If the simulation is to be used once or perhaps only two or three times a year, the cost of familiarisation and risk of self-tutoring is great compared to hiring in an expert.

Computer Literacy
Today's simulations are designed to be used by the average trainer. However, many are still afraid of computers. If this is so or the computer to be used is supplied by a third party, ensure that the simulation is loaded and tested well before it is run. Also ensure, that a "computer expert" is available to help if necessary. If this is done then there are no reasons for using an external tutor. (Although the software must be fully tested and, if a printer is utilised, this tested.)

If you have not used simulations before, using an external tutor for the first run of the simulation provides an opportunity to learn from him or her. A lower cost alternative is to ask the simulation supplier to provide telephone support during the first run. (Often pressure means that items may be overlooked and an experienced, calm, trainer at the end of the phone can help. I have "diagnosed" for users an unplugged computer and write-protect set on floppy discs.)

Commercial Aspects
These notes provide an indication of development costs (the providers' investment) and discuss ways in which the provider protects this investment (copy protection). Finally user costs and purchase options are described and discussed.

Development Costs
Although it is possible for the development of a complex simulation lasting two or so days to exceed one hundred thousand pounds sterling ($150,000). A better figure, where the developer has a library of software components, is between a half and a third of this. Even so, development costs are high. Also, the designer may insist on retaining copyright and so the user is purchasing the right to use the simulation rather that the sole right to the simulation.

Less complex simulations are less costly to develop and cost is approximately proportional to duration. So, a one day simulation might cost between sixteen and fifty thousand pounds sterling ($25,000 to $75,000) depending on the ability of the developer to reuse software components from earlier simulations. However, if the new version

involves only cosmetic changes to the database the cost may only be a few hundred pounds or dollars.

These costs are based on the situation existing in the middle of the 1990s. In the future, increasing labour costs are likely to be balanced by an increasing use of object oriented methodology (reusable software components). However, increasing hardware capability means that additional functionality can be added to simulations. Besides graphic interfaces and network access this functionality includes comprehensive tutor and participative support systems. Since tutor and participant support systems are dependent on the simulation, its learning objectives and the target audience these costs are not reduced greatly by object methods.

Copy Protection

To protect the investment in the development of the simulator it may be supplied with some form of copy protection. (This is a necessity because software piracy occurs and is not seen by many as criminal theft).

- Thought -

Software pirates should be treated as we did the eighteenth century pirates - hung, drawn and quartered. Hung until nearly dead, cut down, entrails drawn and then hacked up for dog food.

The most usual forms of copy protection are in software or using a hardware device. Software protection prevents making multiple copies of the simulation. The copy-protected software may be transferred between discs (and therefore machines) but back-up copies cannot be made. The availability and reliability of today's hard discs means that this is a viable form of protection. However, there is still some risk that the software becomes corrupted and, as there is no back up, becomes unusable. The alternate copy protection - the "dongle" - allows multiple, back-up copies of the software to be made. However, the software can only be run on the machine that has the dongle attached. Against this the dongle is a little unwieldy. This is especially true if the client has several items of protected software, each with a dongle. Also, dongle protection is significantly more costly than software protection. Finally, the installation of the dongle may be perceived as technically difficult (which it is not).

User Costs

Besides the cost of the simulator, these cover:

- **PREPARATION TIME**
- **CONSUMABLES**
- **SUPPORT COSTS**

Preparation Time

It is necessary to budget time to become familiar with the simulation, software, tutor and participant documentation. Also, for critical use and new simulations a trial run is essential.

Consumables

If the supplier waives copyright then this is just the cost of photocopying. Otherwise participant briefs, decision forms and worksheets must be purchased from the supplier. (If copyright is not waived then photocopying is theft. Also, purchasing replacements from the supplier means that you keep in contact. This can be very helpful if you need advice several months or years after purchase.)

Support Costs

As described earlier, you may wish to use an external consultant.

Procurement Options

Simulations may be:

- **OUTRIGHT PURCHASE**
- **RENTED/HIRED**
- **SUPPLIED FULLY TUTORED**

Each of these has different issues that must be allowed for.

Outright Purchase

Actually, as is common with most computer software, what is purchased is a perpetual right (licence) to use the software. If the simulation is to be used frequently, this is probably the best option. However, the "life of the software" and after sales support must be considered. The life of the software is not infinite as operating systems change. For example, when Microsoft introduced Vista and Windows 7, the first thing I did was to buy a computer with the new operating systems to check that my simulations worked on the new operating system (it did for Windows 7 but not Vista and so I had to make changes.) Hardware becomes obsolete, training needs change and simulations are improved. This may mean that the actual, useful life is only a few years, Support from the supplier will be limited, perhaps just to the first three months of use. (Many suppliers of software have moved towards charging for support.)

Rented/Hired

Because of the limited software life and the problems of software support many suppliers provide the software on a rental basis for use on a single course or over a specified period. The rental may be for the simulation software as a whole, on a per participant basis or a combination of the two. Renting means that the software is always the latest version is compatible with the hardware and, telephone support can be expected.

By renting the software as and when needed, you can ensure that the simulation meets specific development objectives, is appropriate for the target group and is of the correct duration. There is the risk that, if the simulation is owned, then this will encourage its use inappropriately (i.e., in situations where the desired learning does not match the learning provided by the simulation). Countering this is that tutors may be more comfortable with a simulation they have used before.

Renting is quite normal for training films and if you compare the rental cost per hour of these with the rental cost of simulation you can judge relative values.

Fully Tutored

The third option is for the simulation to be bought in as a complete package as discussed earlier. Since, besides the consultants time, the package is likely to include rental of the software and documentation, this may be very good value.

Questions to ask when choosing simulations

TARGET USE
What are the development objectives?
How focused is the simulation?
Has this type of manager used it?
Has it been used on management courses?
Has it been used in this, exact way?
Is it too complex for the time available?
What sort of business is modelled?
(replica, reflection or generic)?

SOFTWARE
How long does it take to process decisions?
How quick and easy is data entry?
How are printer problems handled?
How quick and easy is rerunning?
What form of copy protection is used (if any)?

PROVENANCE
How many simulations has the designer created?
What proportion of these were for management courses?
For how long has the simulation been used?
Who has used the simulation?
Does the designer run simulations on management courses?
How was the simulation calibrated?

USABILITY
Can the tutor adjust pressure during the simulation?
How long for the participants to read the documentation?
Can the terminology be changed?
What support and advice is available?
What is the period of free advice?

COMMERCIAL ASPECTS
What is the cost of a perpetual license?
What is the cost of an annual license?
What is the cost of rental?
What is the cost for fully tutored use?
Is the participant documentation copyright?
What is the cost of consumables?
What is the cost of a copyright waiver?
What is the cost of extended advice and support?

OTHER QUESTIONS

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This page may be copied, but please let me know of the other questions you ask.