ABSTRACT
Playing a business game needs to be both educational and entertaining. Thus, evaluation of the experience of playing games needs to incorporate both effective and affective dimensions. This experiment compared the experience of playing the conventional MIT beer game with a prototype electronic version, which had been developed to reduce the complexity and costs associated with the original game. It suggested design enhancements in terms of effective and affective dimensions of play.

General Terms
Human Factors.

Keywords
Design and evaluation methods, affective Human-Computer Interaction, business games.

1. WHAT IS THE BEER GAME?
A game with beer in the title sounds great fun – however, the only thing that the beer game lacks is real alcohol! The MIT ‘Beer Game’ is a role-playing simulation developed at MIT’s Sloan School of Management in the early 1960s as part of Forrester’s research [1, 2] on industrial systems dynamics. It illustrates the advantages of taking an integrated approach to managing a factory style production supply chain. It particularly demonstrates the value of sharing information across the various components of a supply chain and shows the long-term consequences of people’s actions.

The objective of the game is to maximise customer service and profitability across the linked elements of the production of the beer – from the retailer to wholesaler to the beer factory. Each component in the supply chain has unlimited storage capacity and there is a fixed supply lead time and order delay time between each component. On each simulated week, each component in the supply chain tries to meet the demand of the downstream component. There is always a one-week delay in the upstream supply. Any orders that cannot be met are recorded as backorders, and are met as soon as possible. No orders can be ignored, and all orders must eventually be fulfilled. There are “financial” penalties for shortages on backorders and held inventory

Chaos usually ensues as people go from boom to bust as they overestimate and then underestimate demand in the system [2]. Emotions generally run high as blame is usually attributed throughout the linked supply chain elements. Though each player is free to make their own decisions, the same patterns of behaviour emerge every time the game is played. This vividly demonstrates the powerful role of the ‘system’ in shaping behaviours.

2. IF IT AIN’T BROKE…
The traditional beer game has been played all over the world by thousands of people ranging from university students to company chief executive officers. However, the game relies on a specially designed games board, takes a lot of time to play and requires the services of a trained facilitator – and they can be thin on the ground or vastly overworked. So, a new prototype version of the beer game was designed using a Sensetable [3]. The Sensetable is a touch sensitive graphical user interface which is embedded into the top of a games table. This was designed to orchestrate player moves and drive the game forward without the need for a human facilitator.

The object of this experiment was to compare the experience of playing the conventional beer game with a prototype of the electronic beer game and suggest how the game could be improved in terms of both effective and affective dimensions of play.

3. PLAYING THE GAME.
The evaluation team ran two beer game sessions with two teams of eight players competing against each other. The first session was a conventional, facilitator run beer game using the game boards. The second was a non-facilitated version of the beer game using the Sensetable to drive action. Both teams played both conventional and electronic versions of the game.

Data was gathered on both the effective and affective aspects of game play in both sessions. This comprised of:

- Questionnaires that covered team working, facilitation, learning, satisfaction and usability.
- PrEmo questionnaires [4] gauging emotions evoked by each version of the game using an expressive cartoon character.
- Participant observation – with two observers embedded within each of the teams. They noted any
conversations and body language that they believed were of interest to either effective or affective elements of game play.

- Structured interviews with selected participants.

The conventional and PrEmo questionnaires plus the structured interviews were administered immediately after each of the two games sessions.

4. AFTERMATH.

4.1. Evaluation of Game Effect.

Data about the effectiveness of the games were primarily gained through the questionnaires, with additional data provided through participant observation and player interviews.

The percentage of people who thought that the electronic game encouraged teamworking was significantly less (48%) than with the conventional game (92%). This was reinforced by observations during the conventional game that interactions were taking place that were not directly related to play. The speed of the electronic game meant that energies were directed at the game board rather than at other members of the team, so less team interaction and general banter was occurring.

Similarly, learning was perceived to be less (54% said they had learned something from the conventional game verses 20% with the electronic). Again, the speed of the electronic game meant that there was faster strategising with much less thought or team discussion invested in the ordering process. One player randomly ordered 200 barrels and pressed return without blinking! (This is linked with less sense of stock movement in the electronic game). This was also reflected by the data investigating the clarity and aesthetics of the information presented – with 86% reporting that the conventional game was clear and understandable and 58% with the electronic. 91% stated they found the conventional game mentally stimulating compared with 58% for the electronic.

On usability, the most significant difference was around understanding what to do next – with only 50% reporting problems with the conventional game (one player commented that he “had no idea what the strategy was”) compared with 70% for the electronic version (players commented that “at least in the board game I thought I knew what I was doing - I’m pretty lost here!”). There was, in the electronic version, a tendency to press buttons randomly until something happened. This was not helped by the (lack of) sensitivity of the Sensetable to multiple finger touches.

This was also reflected by the data investigating the clarity and aesthetics of the information presented – with 86% reporting that the conventional game was clear and understandable and 71% rating presentation as attractive, compared with 42% and 57% with the electronic.

The electronic version of the game came out as marginally stronger than the conventional game in two dimensions: game duration and the player’s perception of control.

The conventional game took 1 hour and 35 minutes to complete a cycle of 35 weeks. The electronic game took a mere 28 minutes to reach 35 weeks. 12% of players thought that the conventional game was too long, with 6% of players reporting that the electronic version was too lengthy. However, players reported that the impetus and sense of urgency in game play that was encouraged by the human facilitator was not evident in the electronic version.

50% of players reported that they felt more in control of the electronic version of the game against 42% with the conventional version. This is largely because the electronic game would not permit players to do things that were against the game’s rules so players did not need to continually check whether they were doing the right thing, as they were in the conventional game.

4.2. Evaluation of Game Affect.

The PrEmo method [4] was chosen as a tool to evaluate the affective aspects of game play. PrEmo uses a number of cartoon characters arranged in a series of positive and negative semantic differentials to assess emotional reaction using user self report.

The PrEmo questionnaires unearthed a number of differences in the emotional reaction that the two games provoked (emotion labels have been added to the cartoon figures for clarity).

Figure 1: Results of PrEmo evaluation.

Of the total emotions reported using PrEmo:

The original game:

- 68% reported overall positive affect.
- 21% reported overall negative affect.
- The highest scores related to ‘Amusement’ and ‘Fascination’.

The electronic game:

- 31% reported overall positive affect.
- 68% reported overall negative affect.
- The highest scores related to ‘Amusement’ and ‘Boredom’.
- 3 people reported ‘Dissatisfaction’ with the game.

The affective data was reinforced by the participant observation. Body language in the conventional game was generally positive (i.e. forward posture with engagement in game playing). Observed instances of disengagement (often leaning back with arms folded) were usually borne out of frustration. Interestingly, frustration in the conventional game was frequently directed at other players, whereas frustration in the electronic game was almost exclusively directed at the system.
5. CONCLUSIONS AND DESIGN IMPLICATIONS.

One key result for both versions of the game is that they were perceived to be amusing – a key quality in a successful game. However, the levels of engagement (fascination vs. boredom) could not be sustained by the electronic game.

Although the electronic beer game seemed less effective in terms of dimensions such as teambuilding and learning, it did offer higher levels of perceived control to players. The usability of the electronic prototype did tend to cloud perceptions of effective play even though players stated that they found the conventional game “fiddly”.

One of the biggest differences between the two versions of the game was the lack of facilitator influence in the electronic game. This caused the impetus for play to lag.

This combination of effective and affective evaluation was used to feed design recommendations into the electronic game technical team. These included:

- Improving the usability of the electronic game – in particular the sensitivity of the Sensetable, the clarity of the supply chain roles and the sense of game flow.
- A multimedia introduction to explain the basic concepts and rules of the beer game. To encourage interaction between players, the electronic game rules needed to emphasise the role of collaboration and strategy.
- Introduction of a more explicit facilitation mechanism (or at least a timer mechanism).
- Suggesting that more than one table is required and that, ideally, multiple tables should be networked together to encourage more competition/teambuilding to take place. One of the major problems with electronic version was that, due to the relative small size of the Sensetable, there was a restriction on the number of players that could interact with the table at any one time.
- Since players had less of a feeling of tangible stock movements in the electronic version of the game there was a suggestion that a more tangible interface, e.g. physical counters, could be used with the Sensetable.

It is acknowledged that there may have been some element of order effect bias introduced since the players experienced the original game first and then evaluated the electronic version in the light of the original. However, the time constraints of the evaluation project prevented the experiment being rerun with the electronic game being played first.

However, the experiment did prove the advantages of taking a multifaceted data capture approach combining traditional quantitative data with affective data in a game play environment. By doing this, the evaluation team got access to data which was relevant to the emotional experience of playing the game as well as practical usability data.

6. REFERENCES


