Editorial

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1 Introduction

This is not a special issue about game design (or computer game design), although it would definitely be worth considering such an option for a future issue of the 'new' *Journal of Design Research*. The papers in this gaming issue examine the ways in which various types of games and simulations can enrich or enliven the teaching and practice of design and engineering. Our starting point is the belief that we are on the verge of a new (and perhaps revolutionary) approach to education in design and engineering, as described in Clark Aldrich's best-selling book (Aldrich, 2004)!

As guest editors we therefore invited authors to explore the use of games and/or simulation *in* and *for* design, addressing both technical issues and the social context of design.

2 Why games, why now?

> My own quite impressionistic view is that a game is a particular way of looking at something, anything. (Abt, 1970, p.5)

Games can be much more than entertainment! Abt (1970) wrote a book with the intriguing title *Serious Games*. Almost 40 years later, this concept literally and figuratively brings together hundreds of game researchers, game developers, universities, training and consultancy companies and public organisations from all over the world (Serious Games Summit, 2005, 2006).

Indeed, analogue and digital games produce their own images, narratives, technologies, interactions and communication. Intentionally or otherwise, these seem to spill over or cross over into the more analogue worlds of business, public policy-making, and education. This effect also extends to design and engineering, of that we are sure. Throughout the world, there are now numerous high-profile public and private initiatives dedicated to the development, research and use of serious games (cf. Woodrow Wilson International Center for Scholars, 2006). There is now a marked focus on digital games developed and used for purposes other than entertainment. These games are designed for education, healthcare, public policy, risk management or security management (for an extensive catalogue of such games see: Social Impact Games, 2006; for more links see also our CPS website, (CPS, 2006)). Private institutions are exploring the use of games for public policy-making, education, training, communication and persuasion

(Persuasive Games, 2006). Some might be games originally developed for entertainment purposes, such as SimCity, which can also be used for non-entertainment purposes, such as for lectures on urban planning. Other games might be modifications of existing games or game-engines. Some are sophisticated and realistic simulations of real world systems that have the *look and feel* of a computer game. They can address abstract political matters, communicating details about issues such as democratisation, presidential elections, healthcare reform, airport security (or the lack thereof), terrorism, emergency aid, food programmes or global warming. Many of these games are distributed through the internet. Some require the payment of a small fee, others are available as free downloads. Some games are sophisticated technological applications, serving niche markets such as the military or the training of emergency rescuers in the post-9/11 era (cf. Hazmath, 2006). In taking stock of these developments, we therefore invited authors to explore, in their own way, the following questions:

- What types of game are being developed and used for design and engineering, and on what new or existing technologies are they based?
- How are games embedded in participatory, interactive or collaborative design and engineering processes?
- What experiences have people had with these games, and what results have been obtained in various areas of the design and engineering disciplines? Particular reference is made to urban planning, architectural design, industrial design, engineering (both aerospace and civil), and the planning of infrastructure (of seaports and airports etc.)

The contributors draw on examples from entertainment video games, 3D games, paper-based role-play, internet-mediated role-play, as well as web-based and computer supported simulation games. The following papers use examples from the fields of product development, architecture, industrial ecology, urban reconstruction, aircraft design and seaport planning.

We trust that this issue will provide a good introduction to the field of games used in the teaching and practice of design. It is intended to give an impression both of what is possible and what is actually being done. To assist the reader, we have provided brief introductions to each of the seven papers in this issue.

3 Theme 1: What designers can learn from video games

The paper "Gaming techniques and the product development process: commonalities and cross applications", by Andrew Wodehouse and David Bradley from Scotland, provides an informative and well-written introduction to what designers can learn from computer games. Rather than developing and testing games of their own, these authors present the results of a Play2Win collaborative research programme on a game-based approach to learning. They observe that:

Good computer games are highly effective in involving users, but generally have little educational or communications context (Norman, 2004). On the other hand, many design and management tasks are often perceived as being tedious. Despite the similarities, there has been relatively little study into how some of the qualities of computer games could be utilised to compliment the design task.

For readers of the journal who are not particularly familiar with computer games, the paper introduces and clarifies some relevant notions, game genres and specific games. These include real-time strategy games, action and adventure games, the *Sims* and *SimCity*. The authors examine

> "… how computer gaming techniques and strategies (can) be used to enhance communication and group design activities in product development teams."

They conclude that the development of gaming interactions has the potential to significantly improve the performance of large, geographically dispersed design teams. They go on to state that more work is required on ways of integrating these interactions into a typical product development process.

4 Theme 2: Game modding for virtual design

The second paper, "Real time immersive design collaboration: conceptualisation, prototyping and experiencing design ideas", by Ralph Johns and James Shaw, shows how modifications of game engines can be used for virtual design in landscape architecture, interior architecture, and industrial design. Of course, modifying games is itself a design process, as the player or 'reader' also becomes a creator or 'writer', which adds creativity and meaning to a game. Johns and Shaw observe in their paper that "real time gaming software" is most commonly used during the presentation stage of design proposals. This involves creating a design with 3D software, outside the game environment, then importing it into the game for a walk through. However, MODS of game engines from 3D 'shooter games', such as "Gary's mod of *Half-Life2*" (a free download), can also be used in the early stages of collaborative design generation, by designing 'in game'. The authors show that this has considerable advantages. It makes 3D virtual design technology affordable, while enhancing enjoyment and motivation in design education. It also challenges and complements traditional design models and practices. This is nicely illustrated by the following quotes from Johns and Shaw's paper:

> (…) gaming engines mark the beginning of affordable but highly-sophisticated software that in future will allow real-time design, simulation and experience to become an integral part of three-dimensional design processes.

Students actively critiqued each other's work, tested their peers' constructs, and discovered in real-time how their designs performed dynamically.

5 Theme 3: Contextualisation of engineering through role play

Computer game technology undoubtedly offers many new opportunities. However, 'no tech' or 'low tech' games, such as social simulations, role play and board games, were being used in education and learning long before computers and computer games became widely available. We should continue to use and develop these resources. While computers can have many positive functions in games (visualisation, animation, simulation etc.), they also tend to marginalise many important aspects of social and political interaction. Board games, role-playing games and social simulations are particularly strong in emphasising the societal and interpersonal context of design and engineering problems.

"Sustainable development training by simulation of an industrial crisis", by Nathalie Lourdel et al. from France, and "The Sureuro gaming experience: making design choices for sustainable refurbishment projects", by Ellen van Bueren and co-authors from the Netherlands, are similar in terms of content and approach. In both cases, a role-playing exercise was used to give the players a better sense of the ambiguity and complexity of sustainability issues in industry (Lourdel et al.) and housing refurbishment (van der Voort et al.). The game developed and directed by Lourdel and her co-authors was played by students of environmental sciences and engineering. It is based on a real case study of events that occurred in a French company, Metaleurop-Nord, between 1980 and 2003. This game stresses the variety of interests, both internal and external, involved in one company's design decisions.

The case of Metaleurop-Nord shows significant social, economic, sanitary and environmental stakeholder interests which are strongly interconnected. The role play places students into a complex situation revolving around land planning, pollution and societal problems and it allows students of various disciplines to cope with these problems in different ways (…).

The Sureuro Gaming Exercise developed and directed by van Bueren, van der Voort and Maas (among others) was used by managers of housing companies in England, Sweden, Germany, France, Finland and the Netherlands. The game stresses the multiplicity of values affecting design decisions in an intra-organisational setting. It allows participants to deal with this complexity both at the strategic level of portfolio management and at the tactical level of design.

The conflicting values become explicit in concrete refurbishment projects, in which housing companies pursue sustainability objectives. The design of sustainable refurbishment plans involves making choices between a variety of short and long-term goals that may be conflicting and competing.

6 Theme 4: Web-enabled role play in engineering education

One of the downsides of role-playing exercises as described above is the fact that they require intensive preparation and facilitation. Players and facilitators need to spend a day or more together in the same room. Participants need to be divided into groups, after which teams are formed and roles assigned. Various practical matters relating to meeting rooms and dates also need to be arranged. Documents have to be distributed, and players must hand in decisions and documents at the right moment. The entire social process has to be directed by one or more facilitators per game session. Web technology could be supportive in this sense. While educational content management systems, such as BlackBoard and WebCT, have occasionally been used for simulation games, this is not the purpose for which they were designed. As a result, they have relatively poor functionality in the context of simulations and games.

The paper "Exercise technology assessment through a gaming procedure", by Gilbert Ahamer and Christian Schrei from Austria, nicely demonstrates how a web-enabled game shell was developed and used to 'host' various games, on a range of topics, in different educational contexts. Their 'Surfing Global Change' (SGC) is very much a conceptual game shell, or as Ahamer and Schrei put it:

SGC is neither a "new learning platform" nor tangible software. It consists of a set of rules and is (like chess) independent of the physical material used. SGC's strength lies in its concepts and pedagogic foundation.

Other web-based role-playing environments of this type that are worth mentioning include Unigame (2006), Ardcalloch (2006), Sieberdam (2006) and Fablusi (2006). These enable teachers in higher education to develop their own games or simulations. They are easy to use and require very little programming skill. Depending on the specific system used, the underlying architecture can provide e-mail, chat room, and video conferencing services. Additional options enable students and teachers to download or upload documents or assignments. The system includes features to make the game motivational, such as voting for the best arguments by placing chips. Environments such as Ardcalloch and its Dutch offspring, Sieberdam are based on a virtual town. They include digital maps, 'yellow-pages' guides and the web pages of virtual companies. The advantage of such systems is that their technical architecture is independent of the content. This means that new games can be developed and implemented relatively easily.

The paper clearly demonstrates the flexibility of their game shell, Surfing Global Change (SGC), as the same procedure and technologies were used for a wide range of issues. These included 'tunnel crossing the Alps', 'power plant', 'water supply', 'fossil CO_2 emissions', 'low-energy houses', 'air quality in Slovakia' and 'impact of mobile phones'.

7 Theme 5: Computer supported simulation-games of complex design systems

One downside of on-line role playing environments is that they do not (as yet) include simulators. Accordingly, there is a risk that students will fail to expand their knowledge of the subject, or that their negotiations will lead to nonsensical situations. Francesco Bianconi, Stefano Saetta and Lorenzo Tiacci, from Perugia Italy, have submitted a paper entitled "A Web-Based Simulation Game as a learning tool for the design process of complex systems". As these authors rightly observe, relational simulation games have been widely used in areas such as business, management and communication, but their development in the engineering field is still very limited. They have therefore constructed a WBSG to fill this gap.

There are marked similarities between this paper and Geertje Bekebrede and Igor Mayer's paper entitled "Design a seaport in a game and learn about complex systems". Both papers focus on the design process of complex systems, a military aircraft in one case and a large seaport in the other. The authors believe that any attempt to simulate a design process of this kind must include two types of simulation. The first of these should be a computer simulation of the technological artefact itself and of its dynamic environment. The second should be a social simulation, of the political and social behaviour of the stakeholders. Bekebrede and Mayer even argue that:

> (…) designers and managers of technological infrastructures, such as seaports, can benefit from experiencing complex system behaviour in a simulation game.

In the WBSG presented by Bianconi et al., several design teams, each composed of three units, engage in a competitive tender for the design of a military aircraft. Bekebrede and Mayer explain how the computer-supported simulation game, SIMMV2, mimics the real processes involved in planning, equipping, and operating the Maasvlakte 2 port area. The construction of Maasvlakte 2 (in the Port of Rotterdam, the Netherlands) will take

place from 2006 to 2036. In both games the players have to make decisions that lead to a simulated design and performance calculation. However, they also have to manage interpersonal relations, e.g. teamwork, disparate interests and competition with other teams. In the case presented by Bianconi et al., the design decisions are input to a simulated aircraft model, which is available through the web. This allows the game to be partly distributed and asynchronous. The game described by Bekebrede and Mayer is co-located and synchronous, which means that two or three small teams play together in the same location, using four laptops within a local area network.

8 Where will it end?

We needed five themes, around which to cluster seven papers. This in itself illustrates the wide range of opportunities for using simulation in and for design. Engineers, social scientists and education professionals have all discovered the opportunities offered by simulations. These groups have each independently developed simulations to suit their own purposes. The papers published in this special issue deal with a variety of game types (web-based game shells, paper-based role plays, digital games) and some nice examples of various combinations of these types. Of course, we have barely scratched the surface in terms of the total range of possible combinations, and the same goes for the potential of serious games. We stand at the threshold of potentially revolutionary developments. From this perspective, the educational potential in terms of design and engineering appears to be unlimited.

We would like to thank all of the authors for their inspiring papers, which we trust will be a source of enjoyment for the readers of this volume. We look forward to constructive and challenging responses, as well as to further papers concerning an area that may represent a truly revolutionary approach to education in design and engineering.

References

Abt, C. (1970) *Serious Games*, The Viking Press, New York.

Aldrich, C. (2004) *Simulations and the Future of Learning. An Innovative (and Perhaps Revolutionary) Approach to E-learning*, John Wiley & Sons, San Francisco.

Ardcalloch (2006) http://www.ardcalloch.ggsl.strath.ac.uk, Visited on March 16.

CPS (2006) www.cps.tbm.tudelft.nl.

Fablusi (2006) http://www.fablusi.com, Visited on March 16.

Hazmath (2006) http://www.etc.cmu.edu/projects/hazmat/, Visited on March 16.

Persuasive Games (2006) http://www.persuasivegames.com, Visited on March 16.

Serious Games Summit (2005) http://www.seriousgamessummit.com/home.html#, Visited on March 16.

Serious Games Summit (2006) http://www.gdconf.com/conference/seriousgamessummit.htm, Visited on March 16.

Sieberdam (2006) http://www.sieberdam.nl, Visited on March 16.

Social Impact Games (2006) http://www.socialimpactgames.com/, Visited on March 16.

Unigame (2006) http://www.unigame.net, Visited on March 16.

Woodrow Wilson International Center for Scholars (2006) http://www.wilsoncenter.org/index.cfm?fuseaction=news.item&news_id=20313, Visited on March 16.