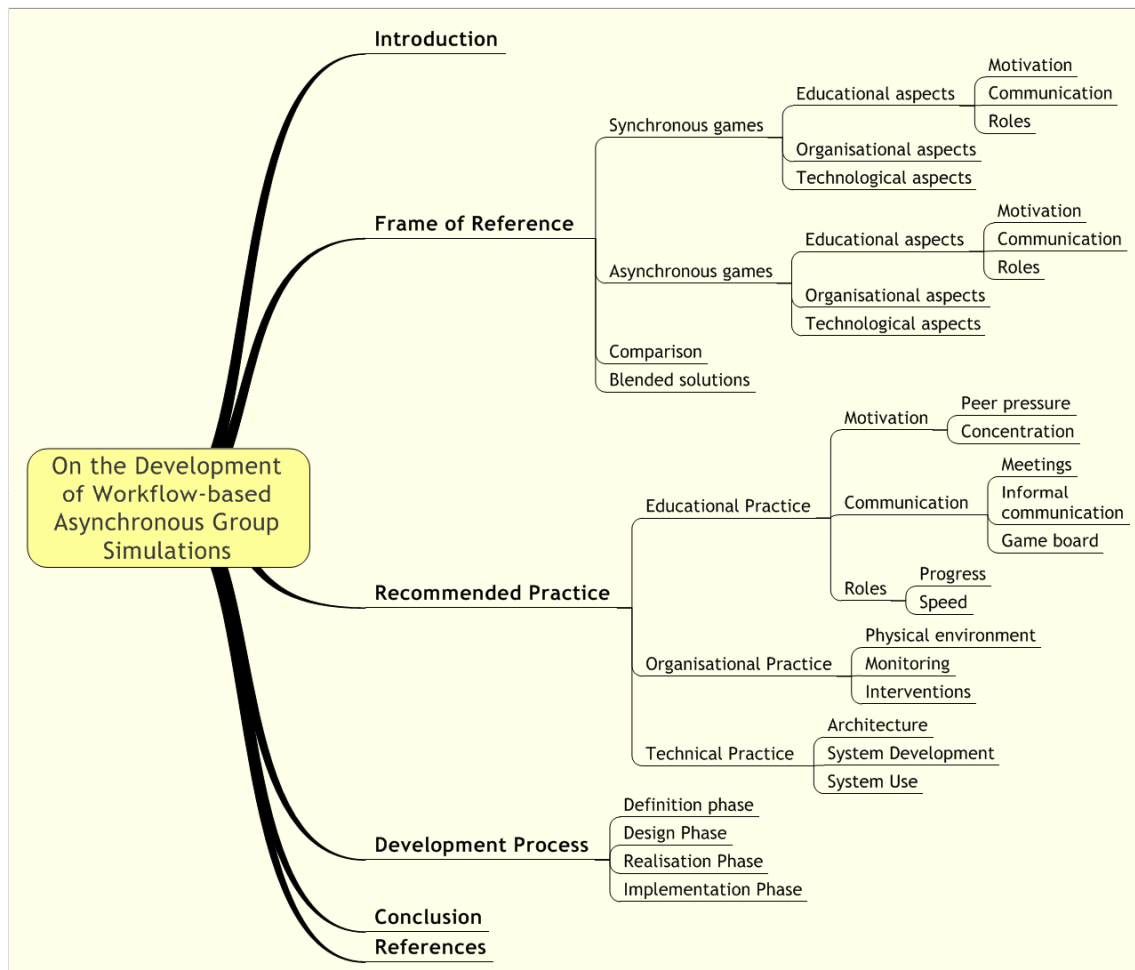


On the Development of Workflow-based Asynchronous Group Simulations

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1 Introduction

In formal education as well as in corporate training, there is a growing interest in competence based learning. After all, the combination of knowledge, experience, and attitude should give learners the best outfit to cope with the challenges of the modern world. Gaming/simulation is a powerful tool to accomplish competence based learning. It could offer its participants an authentic learning environment in the form of a safe, cheap and focused replica of the real world (Van der Hijden, 1996).

Gaming/simulation sessions usually take place synchronously. Group of participants come together in a class room or conference room. The sessions may take an hour, a day, and sometimes a whole week or even more. However, in a growing number of cases these synchronous sessions are less convenient. Students ask for more flexible ways of learning. The market for corporate training requires more and more training-on-demand, just-in-time and just-in-place. Synchronous group simulations do not fit to that need. Fortunately, modern information and communications technology can connect participants located in distant places and even working at different times. This leads to a new type of games, the asynchronous games in which participants are neither active at the same time, nor at the same place.

The following table shows the field of gaming/simulation, subdivided by time and place.

Table 1- Gaming/simulation subdivided by time and by place

	synchronous (at the same time)	asynchronous (not at the same time)
central (at the same place)	typical training games classroom games	(not really used)
distributed (not at the same place)	multi-user entertainment games via internet	e-mail games

Typical training games belong to the synchronous/central category. Participants will communicate by face to face meetings, by document exchange and via a game board. Modern entertainment games played via the Internet, are examples of synchronous/distributed games. They use dedicated computer applications that create their common experience. E-mail games are examples of asynchronous/distributed games (Thiagarajan, 2003). A simple example is playing chess at two different locations and sending the next move by e-mail. The participants do not have to be active at the same moment, although they cannot postpone their actions without limitation. Asynchronous/central games are seldom found.

Information technology (IT) not only serves the asynchronous communication between distant participants. It also orchestrates the session flow by providing the participants with situation dependent instructions, options, and additional information resources. It can connect to a variety of input and output devices. It can calculate the consequences of participant's decisions. It can simulate absent participants. And, of course, it can log any activities for later analysis (Van der Hijden, 1978).

In some computer-supported gaming applications the session flow has been "hard wired" into the software. It is not easy to change it. The game developer or eventually the game facilitator can only replace the texts and documents shown to the participants. Nevertheless, this offers

opportunities to create different games (or cases) based on the same flow. The Scottish virtual city of Ardcalloch by Paul Maharg et al. is an example of this type of games (Maharg, 2004).

Other computer-supported gaming applications offer game developers the opportunity to define and change the workflow, as it is called, themselves. This is not easy. A workflow that will be replayed by a computer has to be specified in great detail. Further, it must be checked over and again, because nothing may go wrong, once the session is running. The Dutch virtual city of Sieberdam/ROCS, inspired by Ardcalloch, is an example of a workflow driven game environment (Schmidt et al., 2004).

Recent software tools that support the international standards for Learning Design, are intended to create and replay learning processes by one or more learners (Koper, 2005). In essence, they are workflow based as well. They may form a sound base to build gaming/simulations upon.

Most literature on the development of gaming/simulations explicitly or implicitly focuses on synchronous games at central locations with conventional means of communication. Although the technology for asynchronous games on different locations is available, information on the educational and organisational practice is scarce. This paper tries to fill that gap.

The paper starts with a frame of reference. It describes the differences between synchronous and asynchronous games. The paper continues with the educational, organisational and technological practice of asynchronous simulation games. Finally, it describes the phases of the game development process: definition phase, design phase, realisation phase, implementation phase. It focuses on what is special for asynchronous games.

2 Frame of Reference

Although they might never have called them that way, many gaming/simulation professionals will be familiar with synchronous/central games. Their main characteristics are so obvious, that they seldom are made explicit. Nevertheless we will do that now, because we need such a description to be able to point at the differences between synchronous and asynchronous games.

We start with a description of synchronous games, played at a central location using conventional communication means. We continue with asynchronous games, played at different locations using information and communications technology. For both types of games we describe educational (motivation, communication, roles), organisational and technological aspects. We conclude with a comparison of both types and describe some blended solutions.

2.1 Synchronous games

Educational aspects

Motivation

The conditions are beneficial for a high and sustained motivation of the participants. Disturbing (or even competing) external activities can be kept to the minimum by simply not allowing visitors to enter the session room, and asking the participants to switch off their cell phones. Sessions can go on without interruptions. Participants experience peer pressure. It stimulates them to remain involved and to try to perform well.

Communication

Roles communicate face to face or via the exchange of written messages or game paraphernalia. There are plenty opportunities for informal communication like non-verbal communication and small-talk, e.g. asking for help or even private affairs.

Roles

Game participants see and observe each other directly. It is clear for everybody who is playing which role and whether the role is played by an individual or by a team. To avoid feelings of discomfort, roles should not differ too much in attractiveness and workload. To attain this goal, it might even be necessary for a game designer to load a role with some pseudo activities. Usually all roles require the presence of the participants during the full session period.

Some roles could explicitly use the openness and visibility of most activities. Examples are a reporter and a spy.

As far as the game design permits, each role can give instantaneous feedback to other roles. A typical game session can take half a day or more. There is no difference between the elapsed time and the real playing time.

Organisational aspects

A simulation session is an event that has to be scheduled carefully. In fact, all intended participants (including facilitators) should be available at the same time and place. All roles will be involved all the time. A conference room is needed and maybe hotel accommodation as well. Travelling time and costs could be significant.

Enrolment of participants can be handled easily. Gaming materials can be reproduced by conventional means (photo copy). The dependence on information technology is low. After the session, a report and/or pictures could be multiplied and distributed amongst the participants.

The facilitator controls the physical environment of the session like room size, furniture layout, temperature, equipment, and game materials and plans the catering. The facilitator allocates the roles to participants and can change this allocation during the session whenever appropriate.

During the session the facilitator knows what is going on by simply being there and looking around. Intervention is possible by giving some comments to individual participants, to role teams or to the whole audience. The facilitator will be visible and busy all the time. Therefore, a facilitator can only handle one session at a time.

Technological aspects

For their mutual communication, roles do not need information and communications technology. However, there might be other reasons to use IT as well.

2.2 Asynchronous games

Educational aspects

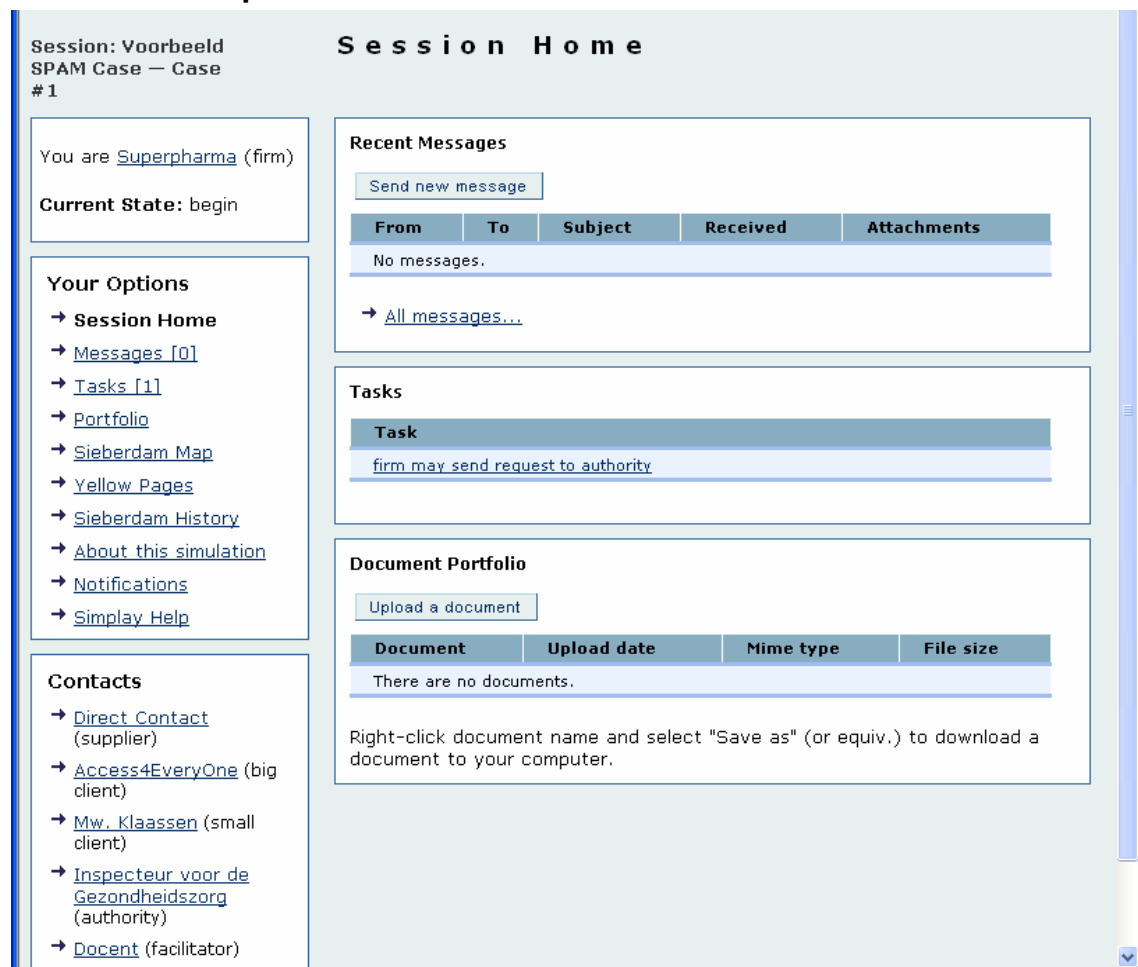


Figure 1- Sieberdam/ROCS user interface

Motivation

The conditions are not favourable for a high and sustained motivation of the participants. Disturbing (or even competing) external activities may draw the participant's attention and hinder their return to the session. Once the participant is online, progress may be delayed due to waiting for other participants to complete their tasks. In fact, from a participant's view, sessions will be interrupted many times.

Facilitators have almost no means to control the conditions for session participants. Participants do not experience much peer pressure.

Communication

Roles communicate via the exchange of virtual messages like e-mail, via the manipulation of virtual objects or, indirectly, via the decisions they take during the game. There is no room for informal communication unless the system provides it.

Roles

Participants do not see each other directly. Unless this information is revealed to them, they do not know who is playing which role and whether the role is played by an individual or by a team. Roles may differ in attractiveness and in workload. Some roles may be played by the facilitator (or even by software!), without the other participants noticing it. Even external experts with little time available could then participate and play a small role.

A participant, who is not online for some time, may block the progress of the session. To avoid this, the game designer can introduce some pseudo activities. For the participant they are serious, for the game progress they are harmless.

Roles like a reporter or a spy which are based on freely observing other roles are difficult to implement. It depends on the information technology used, whether it is possible to provide them with the necessary information.

Roles will not receive any immediate feedback from other roles. Usually, there is a delay. A typical game session may last for weeks therefore. There is a large discrepancy between the elapsed time (maybe weeks) and the playing time (maybe hours).

Organisational aspects

A simulation session is a virtual event that has to be scheduled. During the session period, all intended participants (including facilitators) should be available, but not all the time and not at the same place. The amount of time can be role dependent. The participants may determine the actual moment to participate themselves. The same is true for the location. In fact, the participants only need an Internet connection. No central session room is needed. Participants do not have to travel, nor do they need hotel accommodation. No travelling time is needed; no travelling costs have to be paid.

The facilitator has limited control over the physical environment. The participants control their own physical environment.

Enrolment of the participants will be handled electronically, because the system should "know" the participants. Most gaming materials are distributed electronically. The dependence on information technology is high. When the session has been terminated, some system functions might remain available for the participants during some period.

During a session, the facilitator has no idea about what is going on, unless the system provides that information, either on request or spontaneously. This information will be formal in nature. Also, it depends on the system if and how any interventions or messages from the facilitator to the participants are processed. For the participants, the facilitator will be invisible. A side effect maybe that when a session is not too demanding for the facilitator, more sessions may be run in parallel.

Flexibility in role allocation depends on the system. Sometimes the facilitator has to define a policy (set of rules) that the system will follow through.

Technological aspects

Information and communications technology is indispensable for the enrolment of the participants, the distribution of game materials, the mutual communication, the progress of the game session and the logging of this all.

2.3 Comparison

Synchronous and asynchronous simulation games both have their stronger and weaker points. The table below lists the strong points of both synchronous and asynchronous simulation games. In general, what is strong for the former is weak for the latter and vice versa.

Table 2 - Synchronous vs asynchronous simulation games: strong points

Category	Synchronous	Asynchronous
Educational aspects	Peer pressure Session is not interrupted External disturbances can be avoided Face to face meetings Formal and informal communication Roles cannot block the progress of the game Speed of play is high, intensive	Participants have control over their physical environment Roles may vary in load and attractiveness Roles can be played by external professionals
Organisational aspects	Facilitator has full control over physical environment Easy overview Easy interventions	Participants do not have to travel Participants can choose when to participate Participants can combine game with other activities Facilitator or external professionals may run concurrent sessions
Technological aspects	Information and communications technology is not necessary	All communication can be logged

2.4 Blended solutions

Blended solutions combine asynchronous games with synchronous elements. A briefing session, an intermediate mini-critique session or a debriefing session may be synchronous, either virtual (via chatting or video conferencing), or real.

Another blended solution is to have synchronous teams playing a role in an asynchronous game. When a role is played by a team of participants, these participants come together at a certain time and place (they may choose themselves). As a team they participate in the asynchronous session.

Of course, blended solutions are intended to combine the strong points of both types of games and not the weak points.

3 Recommended Practice

Asynchronous games have their strong points. They also have their drawbacks. Sometimes the system can compensate these disadvantages; sometimes the game developer or the game facilitator has to do that. In the following paragraphs educational, organisational, and technological practices are recommended to make the most of asynchronous gaming.

3.1 Educational Practice

Motivation

Peer pressure

Participants feel little peer pressure. By peer pressure participants will take the game more serious and try to perform well. Peer pressure should be reinforced, therefore. The system makes the participants known to each other and gives them the means to communicate. The participants may prepare homepages for their roles that can be visited by all roles.

The facilitator can increase the involvement of the participants by sending motivating e-mails when something happens in the game. These messages should be attractive and appeal to both sides of the brain. The facilitator knows the time of the last login of each participant. When a participant does not participate anymore, the facilitator is warned and has the means to get in contact, e.g. via ordinary e-mail, sms, telephone call.

To be attractive for the participants, they may personalise their personal workspace (visual style, dialogue language, page components and lay-out).

Concentration

By their nature, asynchronous sessions are interrupted many times. This is disadvantageous for their concentration. To make the interruptions less frustrating for the participants, it should be easy for them to pick up the thread again. Therefore, when a participant is logging off, the system asks a few debriefing questions, e.g. how the participant wants to proceed next time. The answers are fed back to the participant at the next log in, thus facilitating their come-back. Further, the system itself always provides excellent status information. Where we are, how we came so far, where we might go.

Participants are called back to the session by e-mail notification. The messages contain hyperlinks to return to the game immediately and easily.

Communication

Meetings

No face to face meetings are possible. The system has to provide compensating mechanisms for them. The game developer therefore can incorporate tools like a collaborative workspace (intra role, inter roles), a discussion forum, an e-mail list, voting, polling and brainstorming procedures into the workflow.

Informal communication

No informal communication is possible. To compensate this, the participants may upload their picture and use their own name when acting in their role. Informal communication is often used to get help. Therefore, now the system provides help normally obtained from peers, e.g. information on how to deal with the system, reference material on the topic of the game

(glossary, library). The system gives roles the opportunity to exchange e-mails with other roles freely. Maybe participants set up their own means for informal communication. For the facilitator it is interesting to know that. Therefore discussing informal communication should be a topic during the debriefing.

Game board

Often, there is no common (virtual) game board. An alternative construction is to create a special role, say the statistical office. The other roles are requested to send their data to this office. The office subsequently, consolidates the data and distributes its report to the other roles, e.g. as a newspaper article.

Roles

Progress

Roles can block the progress of the game. The game developer therefore sets the maximum time allowed for an activity and determines the exception handling in case this time is exceeded. The game developer carefully checks any possible barriers. Eventual pseudo activities are introduced that do not have a real effect, like interchange without transaction.

Another measure to guarantee the game's progress is to inform the participants in advance on what time investment is expected. Further the facilitator can take over a role temporarily or change the role allocation to participants during the session.

The system displays the (remaining) time to finish an activity to the participants. The system sends notifications to participant and facilitator when time is running down. Participants may specify how this message should be delivered (e-mail, sms, and voice mail).

Speed

The speed of play is low. The game developer gives a participant some optional activities (to pass time) that do not depend on other participants.

3.2 Organisational Practice

Physical environment

The facilitator has no control over the physical environment of the participants. To compensate this, the facilitator sends a briefing to the participants with special attention to their physical environment. Before the game starts, the facilitator sends some physical gaming materials like stickers and posters (maybe even a game board) to the participants. With these materials they may arrange their own session room. Although, you never know whether the participants will do, it is important that their relation with the game is not only a virtual one. At the end of the session, the facilitator makes the physical environment an issue during the debriefing.

Monitoring

Facilitators have limited overview on what is going on. Therefore, the system provides an overview of the session (eventual parallel sessions as well) and their actual status. The facilitator receives a warning in the case of exceptional situations. The facilitator has access to all log information.

Interventions

Facilitators have limited means for direct interventions. However, the facilitator can send e-mails to every role and eventually a participant's role may be taken over temporarily.

3.3 Technical Practice

Architecture

At the client side, the system uses simple, cheap and widely available software like an Internet browser. At the server side the system uses software that is fault tolerant. After a system crash, it should restart any aborted simulation session smoothly. For communication the system uses the Internet.

System Development

The success of an asynchronous simulation game highly depends on the quality of the software. Software for a simulation game can be developed from scratch. However, that is a costly and time-consuming affair. In general, it is far more attractive to use a generic software system that can be filled with the characteristics of a certain simulation game: a workflow description and all relevant documents and other media files.

The system has editing functions for workflows, functions to populate a workflow with documents (rich media), and functions to store and retrieve simulation games (workflows plus documents).

System Use

The system has the following functions to run asynchronous simulation game sessions:

- to facilitate the personal enrolment of participants and to regulate their access,
- to support the facilitator in role allocation at the start as well as during the session,
- to send notifications by e-mail or Mrs to the participants,
- to execute workflows, display status information, and publish documents,
- to offer facilitators the tools for observing the session and for intervening,
- to offer the participants read access to the session's information, even when the session has been finished,
- to offer the participants adequate help information,
- to let participants play different roles in the same session,
- to let users participate in various sessions at the same time.

4 Development Process

A typical game development process consists of four phases: the definition phase, the design phase, the realisation phase and the implementation phase. We give a short description of these phases and stress what is important for asynchronous games.

4.1 Definition phase

The first phase of the game development process is the definition phase. At the end of this phase it must be clear which "problem" this development process is going to solve and in which direction a "solution" will be created.

During this phase, the educational requirements for the game are specified. Which is the real world challenge the game is focused on? Which are the characteristics of the participants? How much support should the game offer to the participants?

Further, the game developer has to explore the organisational context of the game. What is more appropriate, a synchronous or an asynchronous game? Also blended solutions will be considered.

When an asynchronous game is preferred, the policy for software system development has to be formulated: programming from scratch, using generic tools for learning design, using specific tools for asynchronous games, or using an existing game and replacing the game resources.

4.2 Design Phase

The second phase of the game development process is the design phase. The results of the definition phase form its starting point. At the end of this phase the simulation game has to be specified completely. Other people (programmers, graphic designers, text writers) have enough information to be able to really build it. The design is tested for internal consistency and for a consistent application of the definition phase results.

When designing asynchronous games, the workflow of the game (i.e. the whole set of activities that take place during a game), has to be specified explicitly. Only then, it can be converted to software in the right way.

Designing a workflow is not a mechanical process. Numerous questions have to be dealt with. To give a short impression:

- What is really needed to fulfil the games mission?
- What is needed to accommodate a variety of learning styles?
- What is needed to compensate for the drawbacks of asynchronous games?
- What is regulated by the workflow, what is part of the associated gaming documents?
- What should be fixed as part of the workflow, what should be flexible in the hand of the facilitator?
- Which facilitator's tasks will be covered by some special roles in the game (e.g. a judge), which will be assigned to the facilitators themselves?

To avoid a workflow to become too complex, a hierarchical decomposition technique may help. At any level of description, the workflow can then be tested (on paper). Typical problems are infinite loops, deadly embrace (two activities waiting for each other to be completed), roles that might block the whole.

4.3 Realisation Phase

The realisation phase follows the design phase. Now, the real construction of the simulation game (finally) can start. It consists of programming, and/or writing workflows, as well as the creation or purchase of content materials and of all kinds of components like pictures, animations, and video fragments. Finally, all these pieces have to be fit together in the final simulation game. This has to be tested, both by the developers and by other people, e.g. a sample of the intended audience.

In the case of asynchronous games, the game materials and documents are the only links between the distant participants and the game. It is therefore very important that they are visually appealing and attractive.

4.4 Implementation Phase

The realisation phase ends with the delivery of the master copy of the new simulation game. Now it is time to really organise the effective and efficient use of the product. It has to be reproduced and published. This phase ends when the simulation game passes acceptance tests by the client organisation, by the intended users (staff) and by the organisational unit that will be responsible for the systems management.

The success or failure of an asynchronous game depends heavily on information and communication technology. In this phase the product (software and content) has to be transferred to the organisation that is going to exploit it. This requires technical documentation, an acceptance test and possibly training sessions.

5 Conclusion

Being able to participate in games without being bound to time and place offers many new gaming opportunities. There are some drawbacks, however. For educational, organisational and technological aspects, a set of practices has been described to develop and use asynchronous games successfully.

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