



**serious**  
gaming demystified

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# Executive Summary

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The serious gaming industry is a broad market that has grown exponentially over recent years and is expected to reach a 10 billion Euro business by 2015. Serious games are used as the basis for learning by organizations and institutions in many industries to enhance processes or goal sets. This paper offers objective insights with regards to serious gaming in order to demystify its secrets. Although not core to its business, serious gaming is part of Atos' toolkit and the company has developed successful games to bring client needs and the serious gaming world together.

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#### About the Authors

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#### About the Atos Scientific Community

The Atos Scientific Community is a network of some 90 top scientists, representing a mix of all skills and backgrounds, and coming from all geographies where Atos operates. Publicly launched by Thierry Breton, Chairman and CEO of Atos, the establishment of this community highlights the importance of innovation in the dynamic IT services market and the need for a proactive approach to identify and anticipate game changing technologies.

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# Introduction

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**The first serious game to appear in history would be the story of Lydia (modern Turkey) as written down by the Greek historian Herodotus in the 5th Century BC<sup>2</sup>. For many years, there was not enough to eat in Lydia because of bad weather conditions and not enough rain. One day, the Lydian King decided that, in order to save food, Lydians would only eat on even days. On odd days, to take their mind off their hunger they would play dice all day, and place bets.**

Eating on one day and playing games on the other went on for about 18 years according to Herodotus, until the King realized that the country needed a more robust solution. They would play one more time, but for a very high stake. The outcome of the game would indicate who could stay and who had to leave. At the start of the last dice game, the population was split in two. The winner of the game was given the honor of going on an epic journey, leaving Lydia to find a new place in the world and build a new civilization. Enough people and food would be left behind to keep the Lydian society going.

This may sound unbelievable, but a few years ago DNA evidence showed that the Etruscans, who led the Roman Empire until the rise of the Roman republic in 510 B.C., shared DNA with the ancient Lydians<sup>3</sup>. As a result, scientists are now considering the truth of Herodotus' story. If the story is true, it would mean that the Lydians saved their civilization by playing a very serious game.

This White Paper will provide insight into the world of serious gaming by first paying attention to the history of serious gaming and market characteristics. Secondly, it will offer a brief introduction to the learning theory relevant for serious gaming, before becoming more practical and providing classification of serious games and some short case studies.

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# Serious Gaming History, Market Segmentation and Business Models

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According to Wikipedia, a serious game is a game designed for a primary purpose other than pure entertainment<sup>4</sup>. Serious gaming is not a new phenomenon in education and business, the first book about serious gaming was published by Clark Abt in 1968<sup>5</sup>. At the beginning, board, card and role playing games, or a combination thereof, were used to teach people new skills and/or behaviors or explore alternative solutions. In order to qualify as a game, a serious game must adhere to the following principles<sup>6</sup>:

- ▶ The player must be able to tangibly affect the outcome of the game.
- ▶ There must be an overriding goal/challenge as well as sub-goals and challenges with positive and negative outcomes for the player based on their actions.
- ▶ It must require mental and/or physical skill.
- ▶ The outcome must be uncertain at the outset.
- ▶ It must require the player to develop strategies in order to win or succeed. Those strategies needn't be apparent at the outset; in fact the discovery element of gaming is one of its most important strengths.
- ▶ It must offer multiple paths to success. Linear games tend to take the form of puzzles, which, while useful and entertaining are primarily about figuring out a specific question and not necessarily about formulating strategies in a more complex situation.
- ▶ Players must be able to ultimately overcome most obstacles in the game.
- ▶ Only under certain circumstances does it make sense to provide a game that isn't at some point 'winnable'.
- ▶ It must be interesting and fun (relevant to its audience) and inspire repeated play.
- ▶ It can also be educational in nature.

One example of a serious game was introduced to the Army War College by the U.S. military in the late 1970s; the commercial board game Mech War<sup>7</sup>. Mech War is a simulation of tactical combat in West Germany and Asia during the 1970s.

With the broad rise of computers in the 1980s, a new world of (Arcade) games emerged. One Arcade game in particular got serious attention from the U.S. military: Atari's BattleZone. In November 1980, the U.S. army ordered modified versions of the game to be used for training purposes<sup>9</sup>. The result was a serious game for infantry vehicle training under the name 'The Bradley Trainer'. The Arcade game used existing Battle Zone hardware with many modifications. The simulator also used a replica of the controls from a real Bradley Fighting Vehicle<sup>10</sup>.

Since then, the field of serious gaming has become a much broader market, with game objectives spanning a wide array of applications. The term 'serious game' now covers applications ranging from text-based programs to massive multiplayer virtual worlds with huge numbers of Non-Playing Characters (NPCs) each with their own behaviors and artificial intelligence.

Advances have not only been made in terms of new software enhancements, but also within the development of new peripherals for controlling the games. GPS technologies, sensory equipment and mobile technologies have been integrated into several games to provide them with a new way of mirroring real-world problems to be solved.

Such broad use of different techniques has led to a range of names for serious games, including Educational Games, Simulation, Virtual Reality, Alternative Purpose Games, Edutainment, Digital Game-Based Learning, Immerse Learning Simulations, Social Impact Games, Persuasive Games, Games for Change, Games for Good, etc.

The market for serious games has grown exponentially over the years, to the more than one billion Euro business it is today. IDATE, one of Europe's foremost market analysis and consulting firms, estimates that the serious game industry currently generates 1.5 billion Euros in revenue worldwide. There are a number of indicators which will insure its further expansion:

- ▶ Computer power is increasing rapidly and becoming cheaper to purchase.
- ▶ The serious game industry is closely linked to that of video games, which offers new opportunities.
- ▶ Gaming engines and development software are getting more advanced and easier to use.
- ▶ More gaming peripherals are becoming available, for example modern mobile phones are currently increasingly being used as serious gaming devices.
- ▶ More (serious) gaming engines that are easy to use are emerging, not only in the commercial space, but also within the open-source community.
- ▶ Societies depend more and more on technology and are knowledge-driven, so more training is needed.
- ▶ The number of sectors where serious games are employed is growing.
- ▶ Video games are now a significant part of today's culture.

By 2015, it is expected that serious gaming sales will be almost seven times what they were in 2010, which will make the serious gaming market a 10 billion Euro business<sup>11</sup>.

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The serious gaming market can be divided into three major segments: business to business, business to consumer and the combination of the two<sup>12</sup>. In the business-to-business segment, the serious game is developed by an organization on behalf of another company. Within this segment, there are three common business models:

1. The order-based model, a client hires a contractor to design and develop a serious game for the exclusive use of the client.
2. The license-based model, where a serious game product is made available for a fee. The application is either a ready-to-use serious game, a piece of development software to produce a serious game, or a serious game integrated within another application or product.

3. The consulting/training model, where consultants or trainers are trained in mentoring the serious game when being played.

The business-to-consumer model is where a publisher or company designs and develops a serious game, then offers it for sale directly to all types of consumers, without any prior demand or order. This model does not just rely on physical distribution by CR-ROM or DVD, but also electronically via the Internet.

The business-to-consumer model is similar to the business-to-business segment, but in the latter, the owner does not use the serious game exclusively, but also offers it to others.

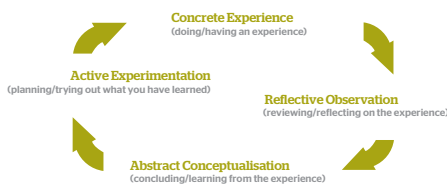
With a dive into history and the explanation of serious gaming market growth, segmentation and different business models, an answer needs to be formulated as to why serious games represent a perfect learning tool.

# Why Gaming? A Brief Journey through Science

Kolb's<sup>13</sup> experimental learning model can be seen as a foundation for serious gaming because it reflects the actual learning process during a game. Kolb's model emphasizes the role of combined experience, perception, cognition and behavior in the process of learning. Learning can be seen as a process in which concepts arise from experience and continuously changing insights.

New skills, attitudes, and knowledge are achieved through a sequence of repeated actions, as shown in the figure below.

Figure 1: Kolb's Experimental Learning Model



The cycle of experimental learning is very similar to the basic structure of a serious game. Consequently, there is an obvious window of opportunity for serious games; to complete Kolb's full learning cycle again and again, on every level of the game, in order to reach the learning goals set. This is in contrast to traditional learning techniques, which will not visit all stages of the learning cycle because the focus is mostly on reflective observation by the student. Serious games offer a more complete and holistic approach to learning in comparison with traditional forms of education.

Learning takes place within a context that is meaningful to the game, therefore learning in a meaningful and relevant context is more effective than learning outside that particular context<sup>14</sup>.

The reason for deployment of a serious game can be roughly divided into the following five categories:

- ▶ Awareness and motivation
- ▶ A serious game to make participants aware of a problem and motivate them to think about and learn to deal with it.

- ▶ Skills
- ▶ A serious game to teach new skills to act and make decisions about whether to opt for an (new) approach to solve problems in particular situations.
- ▶ Knowledge and understanding
- ▶ Serious games offer participants the opportunity to investigate or test possible effects of decisions made.
- ▶ Communication and collaboration
- ▶ Participants may pursue a serious game to enhance communication and collaboration within teams or clients.
- ▶ Integration into a learning curriculum
- ▶ Serious games can be used at the end of a traditional training program. Participants will turn theory into practice by undertaking concrete actions in complex gaming situations.

If the five categories are combined with the role of the game, the intended effect can be highlighted:

Function of the game	Role of the game	Intended effect
Awareness and motivation	Transfer medium	Cognitive, socio-psychological
Knowledge and understanding	Transfer medium	Cognitive
Skills	Practice situation	Extended repertoire of actions
Communication and cooperation	Create conditions	Socio-psychological
Integration of learning cooperation	Practice situation and create conditions	Pre-experience of lessons learned

## So why do serious games really work?

What is known is that games, simulated environments and systems, allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc.<sup>15</sup> Therefore, a proven effect is obvious; simulation is the only way to grasp an effective learning experience. Four years ago, Dr. Cannon-Bowers, a researcher in the field of the science of learning, challenged the effectiveness of game-based learning and serious games at the Training 2006 Conference and Expo:

"We have plenty of empirical studies about simulations over the last 25 years. We know simulations work. We know simulations improve performance. We know simulations improve learning. Yet, I challenge anyone to show me a literature review of empirical studies about game-based learning. There are none. We are charging head-long into game-based learning without knowing if it works or not. We need studies." Dr. Blunt, Director of Plans and Programs for the Department of Defense Advanced Distributed Learning Initiative took on the challenge and three research studies were conducted at a national university to examine the difference in academic achievement among students who did and did not use video games in the process of learning. The result of these three studies showed that classes using a video game had significantly higher means than those classes that did not use any game<sup>16</sup>.

# Serious Games; Classification and Examples

In order to understand possible applications, different genres and the purpose of the game, classification is needed. Ben Sawyer and Peter Smith stipulated this when they rolled out the first version of their Serious Games Taxonomy at the Serious Games Summit, a 'pre-meeting' at the 2008 Games Developers Conference.

According to Ben Sawyer, the current major investors in serious games and simulations for employee training, patient education and student learning are defense, healthcare and education. The fastest growing market sector is corporate training for employee learning and collaboration as they move into virtual-world environments<sup>17</sup>.

The beneath serious games taxonomy will be used as a classification to provide a sense of the wide variety of serious games in different markets. As a consequence, the genre 'Games as work' will not be further elaborated upon.

## Government/Games for Health - Public Health Education: The Great Flu<sup>19</sup>

In 2009, Dutch researchers and game makers developed a serious game with regards

to Swine flu or Mexican flu, to raise awareness about the fight against the virus. The flu was spreading across the world and important decisions needed to be taken to combat the outbreak, measures that might have had major consequences. The goal of the game was to control a pandemic by putting the player in charge of the global flu policy.

The player had to determine the difficulty of the game by choosing from five different levels. In order to combat the flu, a budget of two billion Euro was granted. There were several tactics offered to tackle the virus; an information campaign, for example, cost five million Euros and the storage of antiviral drugs cost one hundred million. Counters on the screen showed the number of global infections and death rates and the state of the budget at any given point in time.

The great flu is playable at: <http://www.thegreatflu.com/>

	Games for Health	Adver-games	Games for Training	Games for Education	Games for Science & Research	Production	Games as Work
Government & NGO	Public Health Education & Mass Casualty Response	Political Games	Employee Training	Inform Public	Data Collection/ Planning	Strategic & Policy Planning	Public Diplomacy, Opinion Research
Defence	Rehab & Wellness	Recruitment & Proaganda	Soldier Support Training	School House Education	War Games & Planning	War planning & weapons research	Command & Control
Healthcare	Cybertherapy/ Exergaming	Public Health Policy	Training Games for Health Professionals	Games for Patient	Visualization/ Epidemiology	Biotech manufacturing & design	Public Health Response Planning & Logistics
Marketing & Communication	Advertising Treatment	Advertising, Marketing with games, product placement	Product Use	Product Information	Opinion Research	Machinima	Opinion Research
Education	Inform about disease/risks	Social issue games	Train teachers/ Train workforce skills	Learning	Corporate Science & Recruitment	Documentary	Teaching Distance Learning
Corporate	Employee Health Information & Wellness	Customer Education & Awareness	Employee Training	Continuing Education & Certification	Advertising/ Visualization	Strategic Planning	Command & Control
Industry	Occupational Safety	Sales & Recruitment	Employee Training	Workforce Education	Process, Optimization, Simulation	Nano/Bio-Tech Design	Command & Control

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## Defense/Advergames - Recruitment and Propaganda: America's Army<sup>20</sup>

Commissioned by the United States military, America's Army is a shooting game that accurately simulates real military training and combat. Its main purpose is to engage users and encourage them to enroll in the real US military<sup>21</sup>.

In the America's Army game, players are bound by Rules of Engagement and grow in experience and hone their skills as they navigate challenges in team-based, multiplayer, force-versus-enemy operations. In the game, as in the Army, accomplishing missions requires team effort.

America's Army is one of the most popular serious games today with more than 11 million registered users. However, the game has also been described as an extension of the military entertainment complex with the criticism levied against it that it contributes to the militarization of society<sup>22</sup>. Nevertheless, the free-to-play game has become a more effective recruiting tool for the Army than all other Army advertisements combined, according to MIT researchers<sup>23</sup>. America's Army is free for download.

## Healthcare/Games for Training - Health Professionals: Pulse!!<sup>24</sup>

An important example in the area of healthcare is the serious game Pulse!! This medical-training game, developed by Texas A&M, was introduced in 2005 and with a budget of \$9.85 million.

Pulse!!<sup>25</sup> is a virtual clinical learning environment for teaching high-level critical thinking, diagnostic reasoning and skills to healthcare professionals<sup>26</sup>.

The objective of the game is to address the shortage of expert-level healthcare educators and to train healthcare professionals in clinical skills in a risk-free environment (to the patient). Today, Pulse!! forms a part of the clinical healthcare curriculum of healthcare institutions all over the world. The importance of a serious game like Pulse!! has been stressed in media coverage in France by *Télématin* on France<sup>27</sup>. It even gave a virtual peak into the classroom.

## Education/Games for Education - Learning: INNOV 8 2.0<sup>28</sup>

The main purpose of IBM's INNOV8 2.0 is to help participants better understand and manage professional business processes. Users play the role of business professionals who must improve their organizations by talking to colleagues and modifying procedures during the game. At the end, a score is awarded based on the results obtained. Innov8 2.0 is a tool to engage IT and business users in a crucial conversation around Business Process Management (BPM). Initiating productive conversations between the two entities, which too often operate at cross-purposes, is one of the more important contributions Innov8 makes to an organization's process optimization.

## Corporate/Production - Strategic Planning: Simplicity Showdown<sup>29</sup>

Philips Electronics has used a game which was intended to help the North American division of the company better understand brand strategy and to improve communication between managers and staff. Teams traveled around the world virtually, visiting landmarks where Philips' products were being used and were tested on Philips' strategy. The 4,000 Philips employees who played had to answer 250 questions over four weeks. The winning team got to hold its annual real-life strategy meeting on a beach in the Bahamas.

Managers first received a postcard from the Bahamas, signed by the CEO, inviting them to play the game. At the office, managers introduced their teams to the game. Ninety-four percent of managers held discussion sessions with their teams over the four-week period and 58 percent of managers held discussion sessions more times than they were required to<sup>30</sup>.

## Industry/Games for Science & Research - AutoMod<sup>31</sup>

In 2004, *Wired* published an article in which Philip Koski argued that the process of working with complex data sets could be improved through the adaptation of game-like technologies<sup>32</sup>. In the field of logistics, large data sets are being used every day by businesses and companies struggling to find the most efficient way to transport goods, vehicles and/or people from A to B.

An approved and established method in logistics to support logistical planning, design and management is simulation. AutoMod simulation software models the design of an airport and allows airport operators to simulate the flow of people (staff and passengers), baggage (security and handling) and vehicles within the airport. This allows the airport to ensure that no bottlenecks arise and highlights areas for improvement or savings. AutoMod offers realistic, automatically constructed, three-dimensional animations, which are being used for validation of the model. All infrastructures in AutoMod are built true-to-scale. AutoMod allows airport operators to study logistics processes at different levels of aggregation<sup>33</sup>.

Although this paper offers just six examples, it is clear that the potential application for serious gaming is almost limitless.



# Basic Functional Design for Serious Games

**Serious game design is the formal method for specifying and planning the educational and fun content and features that support game play and the educational goals of the game for serious video games. The goal of serious game design is similar in nature to that of entertainment games, but is more complex. It must not only maintain intellectual control of the design elements that lead to a fun and engaging game, but must comprise instructional elements that lead to a fun, engaging and educational game experience.**

Robert Gagné sought to understand what processes were necessary for individuals to internalize what is being taught. In his book, *The Conditions of Learning*<sup>34</sup>, he identified nine mental conditions for learning which he called the Nine Events of Instruction.

Through this research, Gagné developed three principles that he considered essential for successful instruction<sup>35</sup>:

- ▶ Providing instruction on the set of component tasks that build toward a final task.
- ▶ Ensuring that each component task is mastered.
- ▶ Sequencing the component tasks to ensure optimal transfer to the final task.

For example, a teacher must teach alphabet recognition in order for students to read words. Only after students learn to interpret or read words, can they then learn to read a sentence, and then two sentences, and then a paragraph, and so on. Gagné deepened his insight in instructional strategies, which lead to the Nine Events of Instruction.

## Nine Events Of Instruction

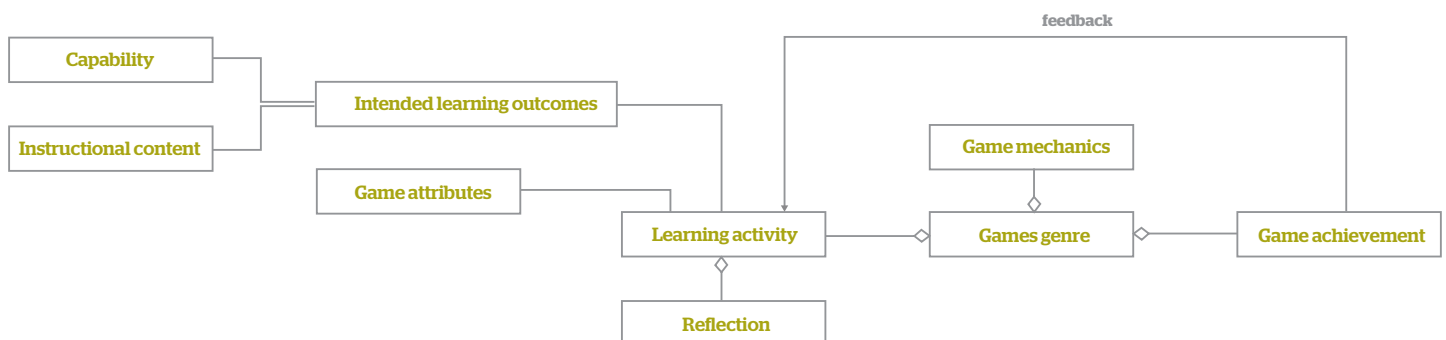
1. Gain the learner's attention.
2. Inform learners of the objectives.
3. Stimulate recall of prior learning.
4. Present stimulus or lesson.
5. Provide learning guidance and instruction.
6. Elicit performance.
7. Provide feedback.
8. Assess performance.
9. Enhance retention and transfer.

Gagné's Nine Events of Instruction are traditionally used to describe an individual lesson, but these events are also being used to describe a curriculum as a whole. In this manner, Gagné's Nine Events of Instruction can also be used to describe both a successful game and individual units of game play. As a result, a formal structure for serious game design emerges<sup>36</sup>:

1. Game Focus/Hook - describe the essence of the game and provide an entry point for gameplay.
2. Didactic Focus - define the subject matter to be taught during game play and provide an entry point for instruction.
3. Provide references to beyond-the-object reference sources, which inform the pedagogic content development for the game.
4. Game Progression - via units of game play - levels, modes, etc.
5. Define the critical path for game play and didactic resolution.
6. Define pedagogic elements to be used.
7. Describe how formative feedback will be distributed during each unit of game play.
8. Describe how summative feedback will be distributed during each unit of game play (per individual lesson) and at the conclusion of game play (per the curriculum as a whole).
9. Describe how replay will encourage retention and remediation of shortcomings.

If the above is combined with a structure for functional game (unit) design, a framework is at hand for describing the functional design for a serious game.

Figure 3: The Functional Design for a Serious Game



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**Capability** refers to the cognitive, psychomotor and possibly affective skills which the player will develop as a result of playing the game. Cognitive skills include the capabilities of recall, analysis, synthesis and evaluation. Psychomotor skills include the capabilities of well-timed, fluid execution of certain actions. Affective skills include the capabilities of identifying, adopting and valuing appropriate attitudes and points of view.

**The instructional content** concerns the subject matter of the game. What will the player learn during the game? This normally concerns four types of basic content: facts, procedures, concepts and principles.

**Intended learning outcome** is a measurable description of the results gained by playing the game. The results to be formulated are related to the application of capabilities and in context with the instructional content offered in the game.

**Game attributes** are the aspects of a game which support learning and engagement. The game attributes are developed based on the critical thinking resulting from the literature review on behaviorist, cognitive, constructivist, educationist and even neuroscience perspectives.

**Learning activity** is the activity designed to keep the player engaged and learning in the game world. Deep involvement or immersion of the player depends on the effectiveness of the delivery of these activities. The majority of game designers spend considerable time in perfecting this area of 'game play' in order to make the game successful.

**Reflection** is where the learner thinks about the purpose of the learning activities that have been undertaken, and decides what strategy to apply during the next activity. Reflection should take place within the game without letting the learner step out of the game world. This can be done by offering reflection activities within the game.

**Game genre** is the type or category of the game played: action, adventure, role playing, construction and management simulation, life simulation, strategy, vehicle simulation, etc.

**Game mechanics** and game rules define the details of the game. The desired learning activities and required instructional content influence game mechanics in order to design a better game that will suit a particular style of learning, a particular target learner or a particular set of intended outcomes.

**Game achievement** is the level of learner achievement in playing these games.

To create a game, technical choices need to be made, such as which platform to use and whether there is a need for employment of a game engine, and if so, what possibilities are available.

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# Game Engines for Building Serious Games

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**One of the biggest players in this industry is Adobe Flash, a multimedia platform primarily used for web deployment. For more serious games, a real game engine is often required, although Flash can still play a role in presenting the game to the end user.**

The core functionality provided by a game engine typically includes a rendering engine for 2D or 3D graphics, a physics engine or collision detection, sound, scripting, animation, artificial intelligence, networking, streaming, memory management, threading, localization support and a scene graph. The process of game development is frequently economized by reusing the same game engine, or a large part of it, to create different games<sup>37</sup>.

Two other terms that are closely related to game engines are 'API' (application programming interface) and 'SDK' (software development kit). APIs are the software interfaces that operating systems, libraries and services provide to allow developers to take advantage of their particular features. An SDK is a collection of libraries, APIs and tools that are made available to program those same operating systems and services<sup>38</sup>.

There are hundreds of commercial and open-source game engines available on the market<sup>39</sup>. In this paper just a few engines will be addressed, which does not imply that these are the only engines to consider when building a serious game. Choosing the right engine is a critical decision and demands careful consideration. Like serious games themselves, there is no one-size-fits-all solution. Serious games are found in several markets - military, healthcare, corporate enterprise and education - each with their own specific needs. What works for teaching advanced weapon systems, negotiating skills or emergency medicine is likely to be different from a virtual environment aimed at teaching algebra, biology or history.

## Thinking Worlds<sup>40</sup>

Thinking Worlds can be used to design single-player, first-person (like Doom) or third-person 3D (Tomb Raider) games and environments in which the player interacts with surroundings, game characters and objects. What makes it a particularly interesting proposition for serious gaming is that it contains the building blocks to create interactions that are suitable for learning scenarios that require little or no programming experience by the developer. Environments can easily be created in which the player can meet and interact with other game characters, have conversations and carry out both simple



and complex tasks. Using question screens and game timers, quizzes and time based challenges can be built. The collection and use of objects to complete tasks, like Tomb Raider, are also possible.

Environments can be brought to life through the use of camera fly-throughs, moving game characters carrying out their own activities, adding effects such as fire and rain, and the use of audio.

One example of the use of Thinking Worlds is a serious game for formal assessment, based on scenarios, for the Scottish Qualifications Authority. This is one of the first times that a serious games-based assessment has been used for formal qualification assessment by a recognized national awards body<sup>41</sup>.

## OLIVE - On-Line Interactive Virtual Environment<sup>42</sup>

OLIVE is a virtual world platform which empowers organizations to create their own secure and scalable, collaborative 3D Internet solutions where employees can meet, collaborate, train, communicate and experiment virtually. It is a sort of Second Life on steroids for the enterprise.

The OLIVE platform has been designed to provide a rich, distributed collaborative user experience in an interactive 3D virtual environment. OLIVE is based on a distributed client-server architecture, which enables applications to easily scale from a single-user application to a large-scale, simulated environment supporting many thousands of concurrent users.

The OLIVE platform itself is a suite of applications, tools and interfaces that enable non-programmers to rapidly create application-specific content and scenarios, while also enabling programmers to develop highly customized virtual world applications. OLIVE consists of a core set of modules and an extendable set of interfaces as defined by the OLIVE API.

A great number of capabilities and functionalities are supported in the baseline platform. This includes fully operational avatars, Voice over IP (VoIP) communication, distributed physics and networking, as well as session record and playback capability. Moreover, a set of general 3D art assets including avatar clothing, gestures, faces, as well as buildings, vehicles, vegetation and many other objects are provided.

The application of the OLIVE platform by the Stanford Medical School project is a clear case study to illustrate the effectiveness of using virtual-world platforms to support training<sup>43</sup>. The project's learning scenarios involved practice innovations through supporting training for cardiopulmonary resuscitation (CPR), mass casualty and assessment in acute-care medicine.

The OLIVE platform was used to support training sessions of medical staff using a replica of the Stanford facility and a number of realistic avatars were programmed to exhibit the signs and symptoms of real victims and patients<sup>44</sup>.

## Unreal Engine 3<sup>45</sup>

Epic's Unreal Engine 3 is a complete gaming development framework (built in C++ with its own scripting language) for PCs, Xbox 360 and PlayStation 3<sup>46</sup>. The Unreal Engine 3 can even be deployed on the iPhone and iPad platforms<sup>47</sup>.

The engine was first used in 1998 in Epic Games' own first-person shooter game Unreal, the Unreal Engine has since been the basis for many popular games, including America's Army, BioShock and Medal of Honor: Airborne. Although the engine was primarily developed for first-person shooter game play, it has been successfully implemented into a variety of genres with different game play, like Tom Clancy's Splinter Cell and Harry Potter and the Philosopher's Stone.

In more serious projects, the engine is also of great value. HKS for example, one of the leading architectural firms in the world, is using the Unreal Engine to bring 3D building models to life on projects such as the W Hotel in Dallas and the Dallas Cowboys' football stadium<sup>48</sup>. Using a virtual walk-through, architects are able to offer their clients a real experience of the constructions to be built.

NASA used The Unreal Engine for the development of a multiplayer online learning game called Moonbase Alpha<sup>49</sup>. This learning game is a precursor to a planned NASA-based massive, multiplayer online learning game project. "Unreal Engine 3 is simply one of the best, state-of-the-art game engines available," said Daniel Laughlin<sup>50</sup>, Ph.D., Project Manager for the game at NASA Learning Technologies<sup>51</sup>. Unreal Engine 3 is a four-time winner and Hall of Fame recipient of Game Developer magazine's Best Engine Front Line Award. And there's more to come; looking at the partnership between Microsoft and Epic, currently making Kinect (Project Natal) part of Unreal Engine 3, and thereby allowing any developer to create Kinect-enabled games when using Epic Games' technology.

## Delta-3D<sup>52</sup>

Game technology can be expensive. Therefore, open source could be a good alternative when budgets are restricted or maximizing profits is an objective. There are several open-source engines available<sup>53</sup>. In this paper, attention will be paid to the Delta-3D engine for its results and for the stable (development) basis which is created by its community and indirectly by the Department of Defense of the United States.

Delta-3D is an open-source game engine built at the Naval Postgraduate School's MOVES Institute. Delta-3D was created to provide a commodity solution so serious games and simulations had a low-cost alternative to expensive simulation suites and game engines. It is built on top of other open-source libraries, which provide much of its functionality<sup>54</sup>. A full description of the reasons for Delta-3D's creation and design philosophy can be found in the paper 'Delta-3D: A Complete Open Source Game and Simulation Engine for Building Military Training Systems'<sup>55</sup>.

Delta-3D is beginning to add more features and improve usability, but it is still a bit technical, making it more than just a low-cost engine. It is a low-cost engine which can deliver a very good result. Proof of this was given when the interactive Damage Control Trainer<sup>56</sup>, which helps Navy recruits prepare for their transition to the fleet, was chosen as the 'Best Business Entry' by a vote of all attendees in the I/ITSEC 2009 Serious Games Challenge<sup>57</sup>. Although Delta-3D is still not at the level of the best game engines used to build AAA titles, such as Epic's Unreal Engine, professional development teams have proven Delta-3D to be capable of creating top-of-the-line simulations and games for a wide range of areas. Delta-3D has matured into an engine that provides the high-level capabilities users need without the high licensing costs generally associated with such capabilities.



Delta-3D© game

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# Final Thoughts, Serious Gaming and Atos

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**This White Paper provides objective insights from different perspectives regarding serious gaming, e.g. historical, business, scientific, design and technical, in order to demystify its secrets.**

With a fast-growing population of skilled gamers in society, for example 83 percent of the US population plays video games<sup>58</sup>, in combination with rapidly improving gaming technologies, making development cycles shorter and projects less budget demanding, broader application of serious games will be highly likely. It is predicted that in 2015 the serious gaming market will almost be seven times that of today. This means more organizations and institutions are exploring the possible benefits of serious gaming to enhance their processes and/or goal sets. As stipulated before, development of serious games is serious business. It requires hard skills from the gaming industry as well as educational, psychological and subject-matter knowledge. A well-prepared plan is more than a prerequisite, as is a multi-disciplinary team for execution.

Although serious gaming is not a core competence within Atos, it clearly sees the positive benefits offered by it. Serious gaming is one of the instruments in Atos' toolkit to raise awareness, prepare organizations for upcoming change and/or to enhance employee skills as needed.

Atos has developed successful games, by itself and with partners, bringing clients' needs and the serious gaming world together, a few examples include:

- ▶ A game for Dutch local governments to raise awareness among civil servants with regards to the impact of eGovernment on their daily work processes, thereby preparing them for the upcoming change due to introduction of new ICT systems.
- ▶ 'SmartGate Learning' for Schiphol Airport in the Netherlands supports the implementation of 'Schiphol SmartGate Cargo' by training personnel of all involved companies. Schiphol SmartGate Cargo aims to optimize security in the air cargo chain by concentrating all controls and inspections. Atos worked with partners to launch the game at the International Air Cargo Forum, which took place from 2 - 4 November 2010 in the RAI Amsterdam.
- ▶ An even greater example of how Atos' subject-matter knowledge, educational insights, technology and gaming development experience really came together is the Nuclear Plant Simulator for EDF in France. The simulator is a full replica of the plants' control room with an accurate representation of the real-time processes. It is used for training operators. It covers most operating conditions, from cold shutdown to normal full power, normal transients, incidental and accidental situations. Talking about Atos' Nuclear Plant Simulator, Yves Manelli, Head of the Industrial IT Department at EDF CIPN (Nuclear Engineering Division), stated "We are counting on Atos to ensure that, for their entire life span, the simulators will continue to be representative of the actual nuclear plant reference and also to guarantee the best-possible availability of simulation tools, improving the instruction of operators in all French nuclear power stations and making it more reliable".
- ▶ Companies interested in demystifying the possibilities of serious gaming for their business should consider Atos to be a serious partner.

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# Notes

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- 1 [http://stage.dev.c2creative.com/interactive\\_showcase/video/Phillips.htm](http://stage.dev.c2creative.com/interactive_showcase/video/Phillips.htm)
- 2 <http://classics.mit.edu/Herodotus/history.html>
- 3 <http://tinyurl.com/34k4wh6>
- 4 [http://en.wikipedia.org/wiki/Serious\\_game](http://en.wikipedia.org/wiki/Serious_game)
- 5 <http://tinyurl.com/2wldago>
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- 7 <http://www.boardgamegeek.com/boardgame/5383/mechwar-77>
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- 11 <http://tinyurl.com/32ppu3u>
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- 30 <http://tinyurl.com/39293az>
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- 45 <http://epicgames.com/technology/compare%20%20en>
- 46 <http://www.unrealtechnology.com/features.php?ref=technology-overview>
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- 49 <http://tinyurl.com/39aeayt>
- 50 <http://tinyurl.com/brh3d5>
- 51 The NASA Learning Technologies project supports the development of projects that deliver NASA content through innovative applications of technologies to enhance education in the areas of science, technology, engineering and mathematics.
- 52 <http://www.delta3d.org/>
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# About Atos

Atos is an international information technology services company with annual 2011 pro forma revenue of EUR 8.5 billion and 74,000 employees in 48 countries. Serving a global client base, it delivers hi-tech transactional services, consulting and technology services, systems integration and managed services. With its deep technology expertise and industry knowledge, it works with clients across the following market sectors: Manufacturing, Retail, Services; Public, Health & Transports; Financial Services; Telecoms, Media & Technology; Energy & Utilities.

Atos is focused on business technology that powers progress and helps organizations to create their firm of the future. It is the Worldwide Information Technology Partner for the Olympic and Paralympic Games and is quoted on the Paris Eurolist Market. Atos operates under the brands Atos, Atos Consulting & Technology Services, Atos Worldline and Atos Worldgrid.

For more information, visit: [atos.net](http://atos.net)