The magic circle: Principles of gaming & simulation

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PRINCIPLES OF GAMING & SIMULATION

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PREVIEW

The field of gaming and simulation resembles a flowering orchard. It is very diversified in two respects. Firstly, scholars and practitioners in gaming and simulation represent a great variety of expertise, knowledge, and disciplinary background. Moreover, they apply games and simulations in numerous contexts of use. Secondly, games and simulations come in many different varieties, covering the whole spectrum from role-play to digital games. Grasping the big picture is not simple. Key terms are "play", "game", and "simulation". "Play" refers to a certain kind of human activity, and "game" to a certain setting, or form of play, which allows for, or triggers playful behavior. The term "simulation" refers both to a dynamic model, an image that represents a reference system, and the running of that model. A simulation is a functional model that imitates the behavior of a reference system. That reference system can relate to an existing system - in real life - or to a purely abstract system with no direct connotation to empirical reality. In other words, with respect to such an abstract system - expressed in a formal mathematical language - the rules of correspondence with some reference system may not be defined, or they may not yet be relevant.

To grasp the meaning and potential of gaming is an important goal for a variety of disciplines, each of which use different theoretical backgrounds and methodologies. This diversity of approaches results in a many-sided image of gaming and it makes building bridges between particular perspectives both necessary and difficult. One possible solution is to explore specific domains, where different fields of study converge. Such an approach can provide a more detailed characterization of the common problems, as well as highlight the interpretative limitations of the specialized areas of research and practice. That is, defining and investigating the existing points of convergence promotes establishment of foundations for a more coherent understanding of the field. In this book, I will present such a common and converging perspective. It goes beyond the specific knowledge domains of (mono-) disciplines and enlightens gaming from the viewpoint of social systems, more particularly social systems as complex self-adaptive systems. It offers a meta-disciplinary view, connecting various levels of organization, and understanding.

The terms "play" and "game" have been used interchangeably as if the two are the same. In this book, I will focus attention on games - forms of play - and gaming, which is a basic form of both human activity and human expression. While entering a game, and assuming the role of player, people temporarily enact a world, which is a class of its own. Interactively they shape a narrative and write local history. The enacted worlds can be purely virtual, imaginary, even disobeying laws of nature. Games can be designed as images of existing social systems with certain rules of correspondence in mind. As Huizinga pointed out in his book "Homo Ludens":

> All play moves and has its being within a play-ground marked off beforehand, either materially, or ideally, deliberately or as a matter of course. Just as there is no formal difference between play and ritual, so the "consecrated spot" cannot be formally distinguished from the playground. The arena, the card-table**, the magic circle** [emphasis added by author], the temple, the stage,

> the screen, the tribunal (court of justice), etc, are all in form and function playgrounds: forbidden spots, isolated, hedged around, hallowed, within which special rules obtain. All are temporary worlds within the ordinary world, dedicated to the performance of an act apart. (Huizinga, 1985, p. 10)

Learning to understand and to read what happens in the magic circles of games is not straightforward. Playing games is a total experience. Are we able to produce a coherent image, a leitmotiv, to capture it in scientifically sound terminology? The structure of scientific research forces knowledge to be extracted from a fully integrated world into disciplinary knowledge domains and inference schemes. The gamed experience becomes des-integrated by disciplinary units that is, faculties and departments. Thus, the way scientific research is organized aggravates the lack of coherence in game studies. Proper approaches to game science require at the least a trans-disciplinary, more preferably an interdisciplinary, or even a meta-disciplinary frame-of-reference.

Playing a game is a total event of being involved in a temporary, provisional, and integrated world. In current scientific research, play- and game-studies are scattered over various disciplines. Providing a comprehensive frame-of-reference for addressing the great variety of approaches to gaming and simulation is not a simple task. Such a synthetic perspective on inquiry and practice should allow the gaming and simulation communities to accumulate a common understanding of principles. Making coherent distinctions between the different types of games and simulations - to learn to see the forest for the trees - requires a commonly accepted conceptual framework. That does not yet exist. Gaming is a science, an art, as well as a craft. Especially as a specific craft within various professional communities, it is stubborn to change and adjust to outside incentives. This hampers cross-fertilization.

Games and simulations as a particular field of scientific enquiry and professional practice have been developed since the beginning of the twentieth century. Simulation and game design and their use, on the basis of varying tools, such as paper, pencil, boards, computers, simulation software, multi-media hard- and software, and the Internet, have been addressed widely in the literature. Simulation and gaming methods are being used in the natural sciences such as physics, chemistry, biology, computer science, in engineering, especially by those who are active in advancing cybernetics, control theory, and (general) systems theory, as well as by behavioral and social sciences such as psychology, sociology, anthropology. More recently, the humanities have become increasingly engaged in the study of video- or computer games as expressions of new media cultures. They approach those games - mainly used in the entertainment business - as interactive narratives. Mathematical game theory, and the more recent offspring “multi-agent-based modeling” have gained a solid position in economics. Business simulations and general management games are embedded in the curricula of many business administration schools.

To bring needed order to this rapidly diverging field of viewpoints, approaches, distinct disciplinary lines of inquiry, research and design methods and techniques, and the widely spread professional game cultures, I present an outline for the game science that I will elaborate on the following chapters.

OUTLINE OF GAME SCIENCE

The fragmentation of game science has accelerated since the rapid growth of digital games for entertainment. In this book, I will be looking for the core of game science through combining key qualities of the natural and social sciences, and humanities.

Few scientists have witnessed such a radical change in their area of research and practice as those who engaged in play and gaming since the 1950s. For thousands of years playing games was considered a nice way to pass the time, to relax and unwind, to drive away boredom, and offer solace. Mainly since the 1950s gaming started drawing attention as a viable approach for studying and handling the complex social issues of that time. While searching for the roots of game science, I draw attention to one of the important traces in history of professional practice in gaming that goes back to the early 19th century. About 1810 the Prussian army started to use war games for training officers through re-enacting - simulating - historic battles: learning to fight the last war. War gaming gradually became a standard teaching and training method in the army.

After WWII, former senior US army officers - after becoming company managers - started transferring their knowledge about and experience with war games to company management. The business games that were developed were not meant for entertainment. They aimed at training managers to run their companies in a competitive market: the battlefield becoming the metaphor of the market. In terms of their instrumentality, those early games were elaborate paper and pencil games, often complemented with game boards. The first computer-supported business games, developed during the late 1950s, were simple and cumbersome to develop and risky to run, because of computer breakdown. Only simple calculations on business data were possible.

On a more theoretical level in 1944 von Neumann and Morgenstern had published their classic book “The Theory of Games and Economic Behavior”. They elaborated on a formal, mathematical theory of sequential decision making among rational economic actors. This branch of game science has gained wide attention and academic recognition, bringing forward several Nobel prizewinners in economics.

During the 1960s game science broadened its scope. Scholars from various disciplines such as, sociology, social psychology, international relations, urban management, geography, ecology, health sciences, demographics, started adopting gaming and simulation methods in their research. The resulting applications had many similarities with regard to their form. Basically, they were board games. They differed in their content and disciplinary inference schemes. Also here, calculations were simple and cumbersome.

Nowadays we play on-line multi-media, massively multi-player on-line games from our home computers through the Internet. Rapid advances in information technology and computer science have produced a tool rich environment for the design and use of games. They are driving the wide spread use of digital games for entertainment. The emerging game industry has accelerated since the 1980s, producing numerous games that are attracting globally millions of mainly young players. The game market for entertainment has become big business with an annual turnover of the same order of magnitude as the film industry.

Game science is advancing through these waves of change, driven by the digital computer game industry, computer and information science, as well as through advances in professional gaming practice such as in education, training, public and business management, policy development, health care, and so on. When asking game scientists about the core of their science, one should expect to hear diverging answers. Some scholars and professionals would for example say: “The design and implementation of games for learning, for business management, urban management, or health care”. Others would say:” The design of interactive learning environments and action learning”. Some would remark: ”Game development to enhancing change and innovation”, or “game design for the entertainment industry”.

So far, game science has a poor record with respect to its theoretical foundation. Classifications or classification systems of games are weakly based on comprehensive game theories. Moreover, they generally tend to disregard the duality of views: the outsider/spectator and insider/participant perspective, and the related multiple reality when it comes to commenting on games and play. The variety of games is being labeled on the basis of their empirical and practical familiarity. I will argue why a theoretical underpinning of games, in their capacity of mini-theories of social systems, is difficult to achieve, and how it can be achieved.

In the analytical science tradition, games are mainly used as if they were “natural objects”. They are considered research methods for developing and testing theories. Validating games is a notoriously difficult endeavor. In the design science tradition, focus is on design specifications vis-à-vis operational requirements, on building and assessing artifacts in their operational contexts. Criteria of their success are usability and utility. Emphasis is mainly on instrumental reasoning, and on demonstrating scientific tricks with games. In a tool rich society, technology, and particularly information technology, increasingly is dominating the world of playthings: games and toys.

Viewpoints

The core idea of game science requires that we start paying attention to three questions:

- What is a game?
- What knowledge is involved in game design?
- What knowledge is involved in playing games?

The first question refers to the nature of their being, the existence of games, as well as of the basic categories of their being and their relations. The related ontological questions deal with issues concerning the sorts of games that exist, and how such games can be grouped and related within a hierarchy, and subdivided according to similarities and differences.

The second question concerns the design of those artifacts. For their design and use I will, among others, distinguish between declarative and procedural knowledge: between *knowing that* and *knowing how.*

The third question addresses the nature and scope of the theory of knowledge (epistemology) related to games. Each discipline involved enlightens a particular and partial perspective on game, play, and simulation. For example, considering games as languages, interactive narratives, semiotic systems, or group dynamics implies making an epistemological choice.

Key questions for game designers and facilitators are:

- What knowledge goes into the design?
- While playing, how will participants construct knowledge?
- How do we know what they have learned?
- How do we justify the designer and facilitator’s knowledge claims?
- How do we justify the players’ knowledge claims?

Key questions for game designers and players are:

- What is real?
- What is the nature of the relationship between what game players know and what is known?
- How do the players engage in discovering or constructing knowledge?
- What knowledge does the game player employ to interpret and act during the game, and subsequently interpret and act on the world?
- How do game players justify their knowledge claims?

Addressing these ontological and epistemological questions sets the stage for game science and offers a frame-of-reference for understanding the great variety of approaches.

The basic thesis is that from ontological viewpoint, games are social systems: groupings of people operating both in a natural, and social environment. They consist of interconnected *actors, rules*, and *resources*. The numerous ways they can be read and understood presuppose conceptual schemes for interpreting their great variety of appearances and ways of use.

Philosophers of science emphasize the deeper meaning of play, and its evolutionary role in human development. Huizinga (1955) paid attention to the play element of culture, play as catalyst of culture. Others focus on the art and craftsmanship of game design, and the idea of playful gaming, which implies that some games might not be playful. Still others limit their scope to games for learning. I am mainly interested in the synthesis of these viewpoints. In this book I offer a meta-disciplinary perspective that interconnects and transcends the contributions of the various mono-disciplines in the behavioral and social sciences, humanities, the natural and technology sciences.

Advances since the 1950s have shaped game methodology. Particularly the rapid development of digital games since the 1980s has caused a proliferation of sub-disciplines, each sub-discipline donning its particular lens to study the artifact. This divergence of views stimulates the scientific and professional acceptance of game and play, and broadens its scope. It adds to building cultural capital. However, it intensifies as well fragmentation and hampers a joint search for coherence and cohesion.

Those who focus on the idea of play tend to view each imaginable social situation as an enactment of play. The world, the nation, the company, the institute, and the family, all are examples for actors going on stage, and playing their roles. Those who favor the idea of gaming tend to view interpersonal activities that relate to social, political, cultural, business, economic, and technological processes mainly from the game perspective, emphasizing both the competitive, and cooperative element of human action. Also physical, biological and ecological processes can be modeled as games.

Taking into account the viewpoint of complexity science, three forms of complexity are available: algorithmic complexity, organizational complexity, and organized complexity. Computer science has a keen interest in further exploring algorithmic complexity of games. Game science and eco-systems science share interests in complex adaptive systems and related organizational complexity. Game and social systems science favor the notion of complex self-adaptive systems.

Computer science recently has discovered that digital games offer valuable platforms for research and education in software development and computing. Digital games are considered ubiquitous multimedia services and applications. Computer scientists focus on issues such as, calculability and problem solving, mechanisms for handling interactive and on-line software systems. Related ideas are digital games - interactive virtual worlds - for learning and entertainment: edutainment. To enhance the status of digital gaming for professional practice, the odd term “serious games” was introduced, implying that non-sense games are the reverse of serious games. In the literature I did not yet find traces of a class called “non-sense games”. I will argue why the term “serious game” does not make sense.

By combining art and technology, and computer science and linguistics, computer science and language departments have joined forces. They study computer games and entertainment computing in similar vain, as studying film, and multi-media products. They view digital games as cultural objects that are classified as genres: various forms of interactive narratives. Topics of interest are for example, games as art forms, novel approaches to digital game design, mobile games and games as social networking tools, converging and cross-platform media, cultural and media studies on games, and policy and legislative responses to digital games.

Cognitive neuroscience aims at better understanding feeling, thinking and acting from the perspective of the individual human brain. Research in embodied cognition and simulation of action for understanding others shed light on empathy, sympathy, compassion, and emotional contagion. All are human qualities that surface during game play. Game laboratories offer adequate facilities for conducting basic research in cognitive neuroscience. Advancing understanding how the brain works will help the design and use of games for learning.

Prior to the advent of video games, since the 1960s computers have increasingly been used to support and assist games. *Computer-supported games* have built-in game mechanisms that are inherent to their dynamics. Without these mechanisms the game cannot run. Examples are business games, in which the computer represents the market dynamics vis-à-vis the microeconomics of the participating companies. The players stay in control of the game dynamics. In *computer-assisted games*, the computer keeps track of the data flow and information exchange between the players. The computer only monitors the processes. The players define the locus of control. The class of digital games - video games - fits into what Thavikulwat called *computer-directed games*: high computer control with high computer-player interaction.

From these examples it is understandable that game scientists choose a particular perspective that suits their interests. That diversity of views should not be denied, nor should we try to change it. Nevertheless, it regretfully hampers the development of the profession if all those who are involved only look at gaming through their separate windows. Compare this situation with physics. Although physics consists of various sub-disciplines it enjoys a common notion about the profession through comprehensive theories and shared research methods. Moreover, it applies, disseminates, and utilizes its knowledge through advancing technology. Such a shared image of game science is lacking.

The common question about the core of game and play is not new. Philosophers have raised that question and have reflected on it since the Greek philosophers thousands of years ago. Starting with the 1950s, professionals have been busy with designing a whole variety of games, most recently based on Internet applications, at the cost of finding answers to a series of fundamental questions. What is the meaning of game and play? What is real and what is virtual reality? What knowledge does a person employ to interpret and act on the world? When playing, how do we understand the intentions of other people? How does embodied cognition during game play connect to the world? How do explicit and tacit rules of the game intertwine? How could we build simple and effective games from complex systems? To which extend are games valid models (theories) of reference systems? Are we able to bring forward a general theory of games? Are we able to help players (social actors) to find smart solutions and approaches to complex issues? How do games enhance learning and how do they improve our thinking capacity and action repertoire?

Current answers to these questions are scattered and inadequate. A philosophy of science uses paradigms - theoretical think and action frames - to characterize a scientific domain. Which paradigms relate to game science, and which paradigm has the best chance to emerge and prosper? Suppose we would agree on the paradigm of game science as the science of human action in social systems, which include actors, rules, and resources. The nice thing about this paradigm is its independence of the instrumentality of games. Game activities can be understood indeed in terms of human action. A reasonably well-developed methodology is in place. However, this does not explain most of the key questions in the field. For example, which forms of play are most adequate in the market economy, or in a pluralistic society? Which games as forms of play - if any - are feasible in autocratic societies? How much knowledge is needed for their design, and how to tap that knowledge? How do we recognize and define the best options? What is the most appropriate form for the players?

Architecture

The architecture of games resembles the architecture of social systems. Game scientists view the world through the windows of play and game. Moreover, they device games for intervening in that enacted world. Societies, companies, institutions, and families - in general, social systems - can be understood from the perspective of game and play. Game scientists focus on a better understanding and re-framing of social systems. That capacity does not imply that they claim to know and understand everything about politics, governance, culture, economics, and technology. Through their meta-disciplinary viewpoint they enlighten and enrich qualities of social systems that are hidden from traditional political sciences, sociology, psychology, public and business administration, and so on. The work of the game scientist does not start when someone says: “We have gathered lots of data and information, would you be willing and able to handle this issue?” The work of the game scientist surpasses such a question, because they will need in advance a framework for understanding, modeling and designing social, socio-economic, and technological processes, moreover, imagining options for intervening in them.

An alternative paradigm relates to algorithmic thinking. It brings forward games to simulate social systems, recipes for calculating future scenarios for example through hierarchical, multi-level, multi-actor simulations. This paradigm stresses games as tools for solving social questions. Whereas a physicist tries to capture a phenomenon in a formula, the game scientist will try to grasp a process in a workable design, not being satisfied with a certain pattern or scientific law. It could very well be that such a law does not work in unique practical circumstances, or that it is not ethical to apply it. As a matter of fact, regularities expressed in (scientific) laws are extremely rare in the social domain. Laws that are embedded in legislation are equivocal, allowing multiple interpretations that need to be negotiated. Game scientists are interested in simulating these processes by putting people (social actors) in the “driver’s seat”.

For example, physical laws, which describe and explain hydrodynamics, are well known. That sort of knowledge is widely applied for example in the chemical industry and water infrastructure. This does not necessarily imply that authorities know how to handle flooding. Understanding hydrodynamics is not sufficient to deal with disasters. Needed are methods to simulate flooding in a certain populated area and to offer the actors involved workable response repertoires to prevent or mitigate the damage to people, infrastructure, and ecosystems, taking into account the multiple agencies involved. Such a design is by no means trivial. Moreover, we need to be aware that social systems are reflexive, self-organizing systems with emerging properties. So, what information and knowledge about various aspects of the social system involved are required to effectively design games?

Choosing (social) problem solving through simulation with formal models is a too narrowly instrumental view on gaming. To come back to flooding, designing a game on flooding will certainly take into account knowledge about hydrodynamics. However, it would be simplistic to think that flooding results from these natural laws. Human settlements, their community practice and infrastructure, and level of industrialization in relation to their surrounding ecosystems impact on the risk of flooding. Games depend on smart designs that link human action with the available (natural) resources, legislation (rules), and infrastructure.

In addition to the utility of games we need to be aware that they are valued for themselves. They are temporary worlds apart. Play and games are expressions of our existence.

Cross-fertilization

Eigen and Winkler have pointed out that games deal with natural phenomena. Chance and principles are the basic elements of those games. They asserted that play is a natural phenomenon that has guided the course of the world from its beginnings. Chances and rules underlie games and play in the shaping of matter, in the organization of matter into living structure, and in the social behavior of human beings. Huizinga has argued that play is older than culture as the idea of culture presumes a human society. Animals - who also play - have not waited for mankind. Play exceeds purely biological activity of immediate survival. It is the meaning of actions that is basic to play and games.

Physics studies the inanimate nature, biology animate nature, psychology the living human, and sociology society. Basically, nature is given. Our knowledge about nature is an evolving construction. Society is not given. It is an ongoing process of self-reproduction. The realm of game science extends continuously through its self-made progress, and through the multiplicity of complex systems that mankind creates among others driven by technology. The Internet has opened a new dimension of game science that the game scientist prior to the 1980s was not able to envision, let alone study. Game science is a unique interplay of advances in science, practical applications, instrumentality, craft, and art. This interplay shows in the design and use of games. We are witnessing the early signs of that interplay. It offers a promising road for the comprehensive study of and steering in social systems. Governmental policies and measures utilize only a small part of what is possible from game theoretical and methodological viewpoint. That also applies to managing companies and economies. One of the reasons is the limited access of game scientists to boardrooms in government and industry.

Connecting cultures

An integrated game philosophy shall need to address the question of interconnecting the cultures of the natural, social and behavioral sciences, and humanities. That is a great challenge. Game science increasingly has shown during the last decades that these cultures need each other. This is partly due to key questions that have been raised, and it follows apparently from the abundance of applications. The coupling of these cultures is also driven by the methods and techniques that the game scientists need. Successful applications of game science integrate knowledge from the natural, social, behavioral sciences and humanities with technology. While searching for a game epistemology and ontology, I will connect to the frameworks of the analytical and design sciences.

The purpose of the book is to outline game science by presenting principles underlying the design and use of gaming and simulation. That frame-of-reference will enlighten the characteristics of particular games and simulations from a common perspective. I will pay less attention to instrumental reasoning than on theoretical and methodological questions. The main reason for choosing this road is the lack of a robust methodology that underpins gaming and simulation methods. Game science is firstly a way of thinking, and secondly, a method and a technique. In addition, the framework presented will help to grasp the interplay between forms of knowledge and knowledge content in connection with gaming, interplay that evolves through the action of the players. These notions I consider preconditions for raising epistemological questions in relation to game science and the educational value of games and simulations. They will provide a suitable context for addressing design science and analytical science approaches to artifact design and assessment and theory development and testing.

Due to the high diversity of approaches, the field has to accommodate the great variety of views on gaming, games, simulations, models, and modeling. Therefore, as mentioned above, I will choose an interdisciplinary and where appropriate a meta-disciplinary approach.

Itinerary for reading the book:

Those readers who are mainly interested in getting familiar with games and simulations are invited in reading Chapters 1, and 2 of Part I, and Part III: Cases. Teachers and trainers in addition, should read Chapters 3, and 7. Those who are mainly involved in game design should focus on Part II, particularly to Chapters 4, 5, and 7. Finally, those readers who are involved in research in game science should pay special attention to chapter 3, and Part II. All readers are invited to select relevant cases from Part III, to see how gaming and simulation work in practice. In every chapter, due to the focus on methodology, some parts are abstract and theoretical, other parts are practical.

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