An Exploratory Taxonomy of Business Games

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Abstract

This article proposes a business game taxonomy. The taxonomy creates a comprehensive definition of business games in general and identifies their parameter-defining characteristics. A successful taxonomy can facilitate the comparison of different game-based educational tools and can direct application-based research to a game's most learning-associated components. The field's existing taxonomies within the literature are inadequate for both purposes. The genesis of our five-part taxonomy of business games was both literature-based and intuitive. It is hoped that this taxonomy will serve to develop a global database to be built collaboratively by the community of business game users and developers.

Keywords

analysis, business game, business game taxonomy, characteristics, classification system, community, debriefing, definitions, educational game, game-based learning, global database, learning experience, management education, management game, management simulation, parameters, role-play, simulation, skills, taxonomy

Business games (BGs) are very popular in management education. Almost every MBA AACSB program requires students to play one or more management simulations, and BGs usage is even higher at the undergraduate level (Faria, 1998). Many companies and universities are following this example. Public administrations ask developers for customized business games (Hubble, Richards, & Wilfong, 2011; Keys, Fulmer, & Stump,

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1996). Surprisingly, BGs are not new to the gaming industry. In 1956, the first widely known business game, TOP MANAGEMENT DECISION SIMULATION, was developed by the American Management Association (Meier, Newell, & Pazer, 1969).

Over the years, detailed BGs developed by academics or specialized private developers faced the competition of challenging amusement games about business or management, which were mostly developed without any ambition of teaching business skills or properly simulating a real competitive environment (e.g., OIL BARONS, 1983, or SID MEIER'S RAILROAD TYCOON, 1990). Such market fragmentation has generated confusion as to what kind of games can be called "business games."

In the light of these considerations, the present article aims to do the following:

- to add clarity to the topic by providing a novel definition for the category,
- to define an in-depth taxonomy of BGs able to characterize the different games and to point out trends in the developer community,

Consequently, our research activities have been driven by the following questions:

Research Question 1: How can we provide a definition that covers all BGs in the literature?

Research Question 2: What are the relevant characteristics of a BG? How can they be classified?

This article begins with a brief analysis of business gaming, a historical background, and an analysis of the various BG definitions. Next, we propose our own definition of BG. In addition, we present our five-part BG's taxonomy. The elements in the taxonomy are explained in depth. Finally, we discuss the results and the limits of the research as well as provide some research directions.

Historical Background

In 1955, the Rand Corporation released MONOPOLOGS, an organizational game in which players from the U.S. Air Force had to perform as inventory managers in a simulation of the Air Force supply system. The first widely known business game (BG) was released 1 year later: the AMA's TOP MANAGEMENT DECISION SIMULATION (1956). By 1961, it was estimated that more than 100 BGs existed and that more than 30,000 business executives had played at least one BG (Kibbee, Craft, & Nanus, 1961). In the decades that followed, BG usage in universities and in industry increased dramatically (Faria, 1987, 1998), keeping pace with technological and pedagogical innovations. Of more than 2,300 serious games described in the "Serious games classification" database (http://serious.gameclassification.com), 7.2% belongs to the *enterprise* market segment, while several BGs may be found also in *education*, in *advertising*, and in *state and government* segments, which include more than 60% of the total.

Since their inception, the main purpose of BGs has been to teach. Indeed, Ricciardi et al. (1957) suggested that the BG is an element in a decision-making course, which they had hoped would lead to a sort of war college for business executives. Over the years, "the use of games and simulations in economics has become well established, with a well-developed body of literature to support their use in the teaching environment" (Sutcliffe, 2002, p. 2). In fact, BGs and business simulations have proven to be effective at improving business skills (Greco & Murgia, 2007; Rachman-Moore & Kennet, 2006), although many authors in the field refer to evaluation methodologies that lack in scientific rigor, as discussed by Gosen and Washbush (2004). Indeed, it is difficult to demonstrate that learning occurred through simulation (Anderson & Lawton, 2009).

Lane (1995) explains how BGs combine both gaming and simulation in structured experiences, with purposes that can be recreational, educational, or both. Moreover, "games and simulations can serve as mechanisms for releasing learning that seems to lie dormant in organizations" (Keys, Fulmer, & Stumpf, 1996, pp. 36-37).

The advantages of BGs relate to human integration:

> Simulation games are one very efficient and practical tool to improve the human integration dimension. This means both integration among different people working in the same business process chain and integration between the human and the IT systems. (Savolainen, 1997, p. 221)

In addition, role-playing in the business context can improve soft skills such as decision making, negotiation, and communication (Chapman & Martin, 1995). Larreche (1987) explains how rapid feedback on players' decisions, together with the motivation provided by the competitiveness of a BG, can improve the learning experience.

Finally, Kolb and Fry (1975) have suggested that games and simulations provide a learning-from-experience approach to managerial education. In fact, the authors presented a theoretical framework to illustrate it: Kolb's four-stage experiential learning cycle.

A Definition for Business Game

As Maier and Größler (2000) noted, *management simulator* is often synonymous with *business simulator*. In fact, many of the definitions that have been offered in the literature use the word management as if synonymous with business. This might seem reasonable; nevertheless, games focused, for example, on the management of an airplane (e.g., MICROSOFT® FLIGHT SIMULATOR, 2006), a lawsuit (e.g., OBJECTION! 1992), or on negotiation with a terrorist (e.g., THE NEGOTIATOR, n.d.) should not be considered BGs. In other words, we assume that equating the two is acceptable only when players virtually manage, for example, a commercial firm, a nonprofit organization, a financial portfolio, a department, or a team working in the business area. Although this list is not exhaustive, it helps us to show the broader meaning that we

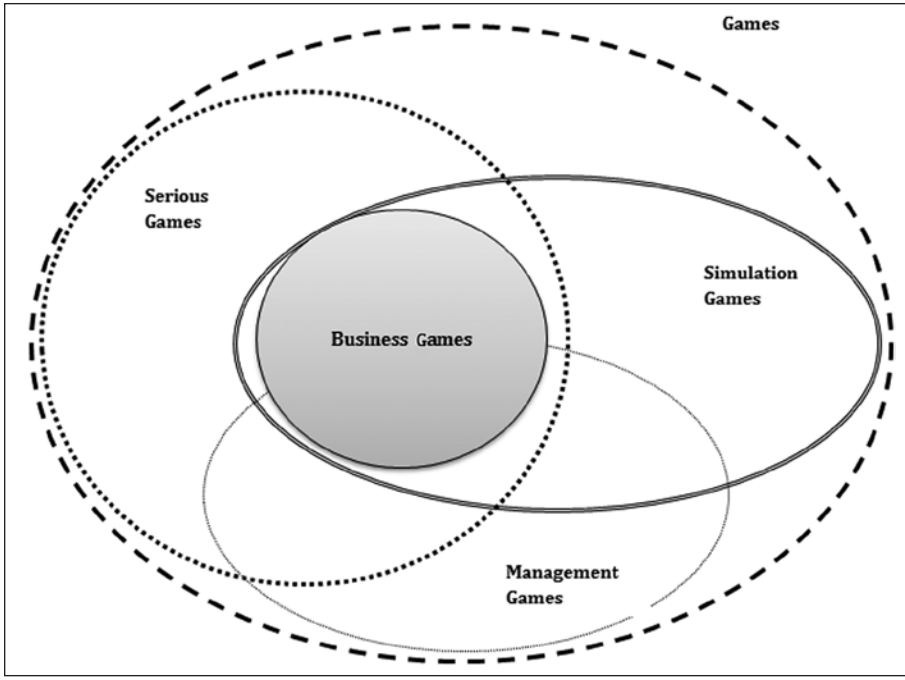

Figure 1. A graphical representation of the set of games and its subsets.

attribute to the word business. Traditionally, a business organization is "an entity formed for the purpose of carrying on commercial enterprise" (Encyclopaedia Britannica); however, the word business is increasingly used also with reference to noncommercial organizations such as nonprofit and state-owned. Thus, in this article, and with the aim of defining *business game*, we consider *business* as a synonym of "related to the management of organizations." Therefore, we argue that management games are not (necessarily) BGs. Nonetheless, in many cases, the two sets do indeed overlap (see Figure 1): For example, in THE GLOBAL BUSINESS GAME (2000), players manage international businesses.

One more important distinction to make is the difference between a business game and a business case study. As remarked by Carson (1969), "Business games are case studies with feedback and a time dimension added" (p. 39). Even though some BGs do not provide detailed feedback (such as an evaluation of the player's performance), on the whole, such a definition seems fair, because almost all of them provide at least a score that can be the basis for generating goal-directed feedback. That said, we would also argue that case studies, for their part, do not provide an opportunity to interact with the environment, such as competitors or virtual markets.

Baldissin, De Toni, and Nonino (2007) states, "Management games are all the simulations used to support managerial learning through an experience that features

competition and rules in the socio-economic environment" (p. 10). Such a definition raises an interesting point: What is a simulation game? What are the differences between a business game and a business simulation game? According to Ruohomaki (1995), simulation and simulation game can be distinguished as follows:

> A simulation is a working representation of reality; it may be an abstracted, simplified or accelerated model of a process. It purports to have a relevant behavioural similarity to the original system.
>
> A simulation game combines the features of a game (competition, cooperation, rules, participants, roles) with those of a simulation (incorporation of critical features of reality). A game is a simulation game if its rules refer to an empirical model of reality. (pp. 13-14)

As the representation could be abstracted, simplified, or accelerated, we argue that a low-fidelity game can be deemed a simulation when it refers to reality. The already cited MICROSOFT® FLIGHT SIMULATOR X is of course a simulation as well as THE GLOBAL BUSINESS GAME, while the former is an airplane management game (i.e., a game that simulates the operation of an airplane), and the second is a total enterprise game (i.e., a game that simulates the management of an enterprise). Thus, each business game that incorporates any of the critical features of the business world should be considered a business simulation game. This is quite important because we are allowed to include in the category those games that, although not simulating a competitive market, refer to dynamics typical of business, such as human resources management, leadership, project management, and negotiation (which are associated with other types of competition). Indeed, it seems that any business game could be considered a business simulation game; that is, BGs should be included in the *simulation games* category.

Eilon (1963) affirmed that BGs have a threefold purpose: they can be used as training tools (in which players must face the consequences of their decisions), they provide an overall view of corporate strategic functions, and they can simulate market trends in order to improve a player's capacity to face changes.

We argue that the focus of a BG's definition should be the purpose of the game, not the methodological technique implemented therein. A generic game could have up to two serious aims: teaching business topics and or evaluating players' performances. Thus, we conclude that a business game is a game with a business environment that can lead to one or both of the following results: the training of players in business skills (hard and/or soft) or the evaluation of players' performances (quantitatively and/or qualitatively).

Much debate centers on whether entertainment-oriented games that have been developed without any serious purpose can improve the business skills of the individual. In fact, in many amusement-driven games, players are asked to make business choices that simulate the ongoing practices of a company or institution. In order to classify such games fairly, we must evaluate how the skills improved by playing such a game are then useful within everyday business settings. For example, is playing

ZOO TYCOON (2001) of use to a real zoo manager? Can the management of a zoo be considered as doing business? According to the extended meaning of *business* that we introduced before, managing a zoo actually is doing business (even though nonprofit). However, it is unlikely that a real zoo manager would use it to improve his or her skills or to train himself or herself before undertaking such job.

As we cannot evaluate the players of these games, we regard as BGs only those games capable of training players directly in skills that can be useful within a business setting. For example, playing "DOOM" (1993) can increase a player's reactivity and multitasking skills, which can also be useful in a business scenario. However, this is a collateral effect of a game in which the purpose is not tied to "being useful in a business scenario." We call this effect *indirect training*. A game that provides indirect business training should not be considered within the domain of BGs. Of course, we exclude, *a priori*, all BGs that offer erroneous teaching and virtual environments that manifest patently unrealistic reactions to a user's choices.

A Taxonomy of BGs

BGs were first classified by Eilon (1963) in terms of their design characteristics (total enterprise or functional, interacting or noninteracting, computer or noncomputer) and according to their expected use: (a) as a part of a general management training program, (b) for selling new techniques or procedures, or (c) for conducting research (e.g., on the behavior of systems, on the decision-making processes of individuals, or on the interaction of individuals within a team).

In addition, we are indebted to Aarseth, Smedstad, and Sunnanå's (2003) classification of games (later refined by Elverdam & Aarseth, 2007) and to Maier and Größler's (2000) classification of computer simulations. It should be noted that in most cases, in order to simplify the analysis, these authors attempted to structure the elements of their taxonomies using binary forms.

Table 1 shows the use of previous work by Maier and Größler (2000), Aarseth et al. (2003), and Elverdam and Aarseth (2007). BGs fit into many of the categories proposed by these authors. However, in order to add new, more significant categories without producing a large and impractical taxonomy, we chose less than half of the possible categories.

Our first step entailed choosing macro-categories, starting with those defined by Maier and Größler. The authors focused on methodological and structural issues, yet did not include several crucial components, such as role-playing, interactions among users, and the creation of communities; thus, we added a fifth macro-category to the four offered in their article *User Relation/Community*. Figure 2 shows briefly the critical characteristics within the five macro-categories of the taxonomy presented hereafter.

Next, we present our own refined taxonomy; we define both the new elements we have added as well as those we have adopted from the other authors. Moreover, we offer disambiguation methods for those categories that may appear subjective.

Table 1. A Comparison of Computer Simulation Taxonomies (Maier & Größler, 2000) and Game Typologies (Aarseth, Smedstad, & Sunnanå, 2003) and a Description of Our Own Proposed Taxonomy for Business Games (the Novel Dimensions of Our Taxonomy Are Underlined).

Taxonomy for computer simulations (Maier & Größler, 2000)	Classification of games (Aarseth et al., 2003)*, (Elverdam & Aarseth, 2007)**	The proposed taxonomy for business games
1. Environment of application	External time**	1. Environment of application
a. Number of users	a. Representation*	a. Degree of integration
i. Single person	i. Mimetic	i. Stand-alone simulation
ii. Multiperson	ii. Arbitrary	ii. Integration in learning environment
b. Degree of integration	b. Teleology*	b. Environment
i. Stand-alone simulation	i. Finite	i. Computer network
ii. Integration in computer-based environment	ii. Infinite	ii. Face to face
c. Main area of application	Virtual space**	iii. Other
i. Modeling-oriented	a. Perspective*	c. Representation
ii. Gaming-oriented	i. Omnipresent	i. Mimetic
d. Use of teachers/facilitators	ii. Vagrant	ii. Arbitrary
i. Totally self-controlled learning	b. Positioning**	d. Teleology
ii. Support by teacher/facilitator/coach	i. Absolute	i. Finite
2. Design elements of user interface	ii. Relative	ii. Infinite
a. Chance of intervention while simulating	c. Environment dynamics**	e. Use of teachers/facilitators/coaches
i. Discrete periods	i. Fixed	i. Totally self-controlled learning
ii. Simulation in one run	ii. None	ii. Support by teacher/facilitator/coach
b. Transparency of simulation model	iii. Free	2. Design elements of user interface
i. Black box	d. Topography*	a. Chance of intervention while simulating
ii. Transparent box	i. Geometrical	i. Discrete periods
c. Advancing of time in user interface	ii. Topological	ii. Simulation in one run
i. Self-proceeding	Physical space**	iii. Continuous
ii. User-driven	a. Perspective*	b. Sequential nature of decisions
d. Characteristics of users' decisions	i. Omnipresent	i. Strict sequentiality
i. Policy-oriented	ii. Vagrant	ii. Explorative
ii. Decision-oriented		

(continued)

Table 1. (continued)

Taxonomy for computer simulations (Maier & Größler, 2000)	Classification of games (Aarseth et al., 2003)*, (Elverdam & Aarseth, 2007)**	The proposed taxonomy for business games
3. Model	b. Positioning**	c. Characteristics of users' decisions
a. Real-world domain	i. Location based	i. Qualitative
i. Business	ii. Proximity based	ii. Quantitative
ii. Other	iii. Both	d. Internal time
b. Structure	Internal time**	i. Haste
i. Feedback-oriented	a. Haste	1. Present
ii. Process-oriented (mostly without feedback)	i. Present	2. Absent
c. Behavior	ii. Absent	ii. Synchronicity
i. Deterministic	b. Perspective**	1. Present
ii. Stochastic	i. Present	2. Absent
d. Generality of model in regard to domain	ii. Absent	iii. Advancing of time in user interface
i. Special area of interest	c. Synchronicity**	1. Self-proceeding
ii. Whole domain	i. Present	2. User-driven
e. Proceeding of time in simulation engine	ii. Absent	e. Transparency of simulation model
i. Discrete	d. Interval control**	i. Black box
ii. Continuous	i. Present	ii. Gray box
f. Role of simulation model	ii. Absent	iii. Transparent box
i. Active generation of decisions	Game state**	f. Appearance
ii. Clearing device for users' decisions	a. Mutability*	i. Text
g. Influence of external data	i. Temporal	ii. Some graphics
i. With such influences	ii. Finite	iii. 2D
ii. Without such influences	iii. Infinite	iv. 3D
h. Domain of variables	b. Savability*	g. User interface
i. Integers	i. Nonsaving	i. Browser based
ii. Real numbers	ii. Conditional	ii. Mobile based
	iii. Unlimited	iii. Software based
		iv. Not digital

(continued)

Table 1. (continued)

Taxonomy for computer simulations (Maier & Größler, 2000)	Classification of games (Aarseth et al., 2003)*, (Elverdam & Aarseth, 2007)**	The proposed taxonomy for business games
3. Target groups, goal objectives a. Width of target group i. Special target group (client specific) ii. Open target group b. Goals regarding users i. Judgment 1. Users are going to be tested 2. Users are not going to be tested ii. Change 1. In attitude toward a specific issue a. Users are going to be motivated b. Motivation not intended c. Learning about modeled system domain-specific knowledge d. Domain independent knowledge 2. Mediation of knowledge about system's control a. Imparting of procedural knowledge b. No imparting of procedural knowledge	Rules* a. Topological rules* i. Yes ii. No b. Time-based rules* i. Yes ii. No c. Objective-based rules* i. Yes ii. No Control* a. Mutability* i. Static ii. Power-ups iii. Experience-leveling (XL) b. Determinism* i. Deterministic ii. Nondeterministic Space* a. Environment* i. Dynamic ii. Static Time* a. Pace* i. Real time ii. Turn based	h. Savability i. Unlimited ii. Conditional iii. None i. Virtual space i. Perspective 1. Omnipresent 2. Vagrant ii. Positioning 1. Absolute 2. Relative iii. Environment dynamics 1. Free 2. Fixed 3. None 3. Target groups, goals objective, and feedback a. Width of target i. Special target group/topic ii. Open b. Goals regarding users i. Teaching ii. Evaluation iii. Research c. Didactic goals i. Soft skills ii. Conceptual skills iii. Hard skills

(continued)

Table 1. (continued)

Taxonomy for computer simulations (Maier & Größler, 2000)	Classification of games (Aarseth et al., 2003)*, (Elverdam & Aarseth, 2007)**	The proposed taxonomy for business games
	Struggle a. Challenge** i. Identical ii. Instance iii. Agent b. Goals ** i. Absolute ii. Relative Player composition** a. Player structure* i. Single player ii. Two players iii. Multiplayer iv. Single team v. Two teams vi. Multiteam Player relation** a. Bond** i. Dynamic ii. Static b. Evaluation** i. Individual ii. Team iii. Both	d. Struggle i. Challenge 1. Identical 2. Instance 3. Agent ii. Goals 1. Absolute 2. Relative e. Debriefing i. Collective ii. Individual iii. Absent f. Feedback i. Absent ii. Immediate iii. Final g. Feedback degree i. Complete ii. Incomplete 4. User relation/community a. Interactions among players i. Direct ii. Indirect iii. Absent b. Player composition i. Single player ii. Single team iii. Two players

(continued)

Table 1. (continued)

Taxonomy for computer simulations (Maier & Größler, 2000)	Classification of games (Aarseth et al., 2003)*, (Elverdam & Aarseth, 2007)**	The proposed taxonomy for business games
		iv. Two teams v. Multiplayer vi. Multiteam vii. Massive c. Player relation i. Bond 1. Dynamic 2. Static ii. Evaluation 1. Individual 2. Team 3. Both d. Role-playing i. Yes ii. No e. Players' community i. Present ii. Absent f. Developers' community i. Present ii. Absent g. Alliances i. Foreseen ii. Not foreseen iii. Not present 5. Model a. Domain i. Realistic

(continued)

Table 1. (continued)

Taxonomy for computer simulations (Maier & Größler, 2000)	Classification of games (Aarseth et al., 2003)*, (Elverdam & Aarseth, 2007)**	The proposed taxonomy for business games
		ii. Fantasy b. Behavior i. Deterministic ii. Stochastic c. Generality of model in regard to domain i. Special area of interest ii. Whole domain d. Influence of external data i. With such influences ii. Without such influences e. Configurability of the model i. Absent ii. Mixed iii. High f. Fidelity i. High ii. Medium iii. Low

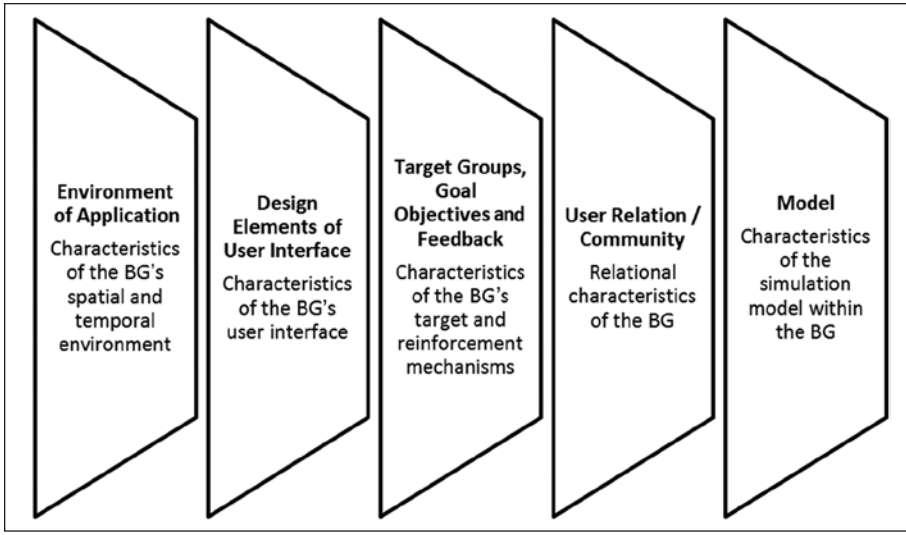

Figure 2. Overview of the five macro-categories of the taxonomy.

Environment of Application

The Environment of Application category describes the spatial and temporal environment of a business simulation. In adopting Maier and Größler's taxonomy, we moved the element *Number of users* to the new category *User Relation/Community*, adding details to it and renaming it in *Player Composition*. In addition, we removed the *Main area of application*, as we considered it too ambiguous to be defined and not critical to the aim of our study. Finally, we added a new element, the *Environment*.

Degree of Integration (Stand Alone Simulation, Integration in Learning Environment)

A BG is classified as *Stand Alone Simulation* if players are not involved in external learning experiences, such as interactions with a teacher and team meetings (e.g., in BUSINESSGAME.BE, 2007, no external learning experiences are foreseen); otherwise it is classified as *Integration in Learning Environment*. For example in WIN WIN MANAGER (2009), the instructor can conduct a debriefing at the end of the negotiations to improve players' learning experience (Greco, Branca, & Morena, 2011).

Environment (Computer Network, Face to Face, Other)

This element refers to the real environment in which a game is played. Players might still need to connect to the Internet or to a LAN (Computer Network) in order to play. In several cases, BGs are played "live" in a classroom (Face to Face). Finally, several

less frequent cases are classified as "Other" (e.g., single-player games). In several cases, players first interact Face to Face in order to share their opinions about a decision, and then submit their decision through a computer network or a software (e.g., in THE BUSINESS GAME, 2010, the members of the teams systematically meet together to choose the strategy to be implemented in the next quarter).

Representation (Mimetic, Arbitrary)

A *Mimetic* representation of time refers to those games in which the time of the actions in the game mimics the time of corresponding actions in the real world (Aarseth et al., 2003). For example, WIN WIN MANAGER in its "live" version allows players to negotiate face-to-face with one other, so negotiations take time just as long as real negotiations would take. In most BGs, time representation is *Arbitrary*, because the time of the actions in the game does not mimic the time of corresponding actions in the real world (Aarseth et al., 2003). For example, in CAPSTONE (2004), each round corresponds to a year in the company's life.

Teleology (Finite, Infinite)

Teleology relates to the final goal of the game. Games with *Infinite Teleology* never reach a clear winning state and could in principle be played endlessly (Aarseth et al., 2003). For example, in BUSINESSGAME.BE, players are involved in an endless Massive Multiplayer Online Game with permanent rankings that are updated each half hour. Games with *Finite Teleology* defined clearly successful outcomes for players (Aarseth et al., 2003). For example, in CAPSTONE, players have from five to eight turns (years in the BG representation of time) to compete for success with a poor-performing company.

Use of Teachers/Facilitators/Coaches (Totally Self-Controlled Learning, Support by Teacher/Facilitator/Coach)

Most BGs do not require the support of a teacher, facilitator, or coach, such as CAPSTONE. On the other hand, in ENTERPRISE EUROPEAN BUSINESS GAME (2009), for example, the teams are accompanied on their path by experts, consultants, professionals, class teachers, and by the national project coordinator.

Design Elements of User Interface

The category Design Elements of User Interface describes the characteristics of the user interface. In order to make a rigorous classification, we added many elements to Maier and Größler's proposal, both including some from other taxonomies (Aarseth et al., 2003; Elverdam & Aarseth, 2007), and introducing new elements (Sequential Nature of Decisions, Appearance, User Interface).

Chance of Intervention While Simulating (Discrete Periods, Simulation in One Run, Continuous)

This element was proposed originally in Maier and Größler's (2000) taxonomy without the *Continuous* label. In CAPSTONE, as well in many other BGs, players interact with the game engine in *Discrete periods* (from five to eight). During our explorative research, we could not find any BG in which players are supposed to interact with the game engine only once, although in some cases an instructor could opt to have players playing only one round or period (even if the BG allows a higher number of turns). Probably such evidence depends on the questionable learning effectiveness and low level of involvement that such a design element could cause in case of *Simulation in one run*. Finally, several games allow a player to interact with a simulated environment in a continuous way, like in AIRWAY SIM (2006). Thus, we completed Maier's element with this new element.

Sequential Nature of Decisions (Strict Sequentiality, Explorative)

From a didactic point of view, Sequential Nature of Decisions is very important. It compares the traditional, linear behavior of games (e.g., one must complete level t to start level $t + 1$), with the innovative explorative approach that allows players exploring the game and choose their own sequence of actions. The explorative approach emerges from web-based learning applications and recurring hypertexts in a learning path. As shown in Khalifa and Lam (2002), interactive, distributed learning websites (i.e., hypertext-based learning material) enable a more active and explorative learning process and a higher level of understanding than the passive distributed learning websites (i.e., linear learning material). On the other hand, the freedom of action afforded to a player can also lead to an incomplete understanding of the subject. To confront this problem, Mitsuhara, Ochi, Kanenishi, and Yano (2006) proposed an adaptive link generation system. Most BGs support strictly sequential decisions, such as CAPSTONE, while others allow an explorative approach (e.g., AIRWAY SIM). One-shot games are a peculiar subset of those allowing strict sequentiality of decisions.

Characteristics of Users' Decisions (Qualitative, Quantitative)

Users' decisions can be strictly quantitative (such as choosing the prices of products, as happens in THE BUSINESS GAME) or qualitative (such as choosing the color of products). BGs often allow making decisions of both types (e.g., in WIN WIN MANAGER, players often negotiate both prices and qualitative variables). Nissen and Ananidze (2007) focus on the importance of qualitative decisions and argue that they are difficult to grasp with conventional simulation modeling; therefore, they presented fuzzy sets to overcome these difficulties.

Internal Time (Haste: Present, Absent; Synchronicity: Present, Absent; Advancing of Time in User Interface: Self-Proceeding, User-Driven)

As defined by Elverdam and Aarseth (2007), *Internal time* describes time within games:

> Haste describes whether the mere passing of real time alters the game state (present) or not (absent). Synchronicity describes whether game agents can act at the same time (present) or if they take turns (absent). Interval control describes whether the players decide when the next game cycle will commence (present) or if such control is denied (absent). (p. 11)

In order to make the sense of *Interval control* clearer, we renamed it as *Advancing of time in user interface*. For example, in WIN WIN MANAGER, players submit their offers and counteroffers in turn (*Synchronicity*: Absent), the mere passing of real time does not alter the game state because players can submit their messages until they find an agreement (*Haste*: Absent) and players can choose whether they want to start the next level or wait (*Advancing of time in user interface*: User-Driven).

Transparency of Simulation Model (Black Box, Gray Box, Transparent Box)

Most BGs are strictly black boxes: You do not know how their models work. Of course, in a game manual, you may find that hiring one new worker will cost \$X, or that machines lose efficiency at a certain rate, but it is difficult to find equations that describe how offer and demand are matched, or how marketing expenses and quality affect market shares. However, the open-source movement has also influenced computerized gaming. Still, it is very rare that a simulation model is fully disclosed to the public (we could not find any BG of this kind). Thus, we decided to include a *Gray Box* tag to describe those games in which the models are only partially disclosed (e.g., in THE BUSINESS GAME, several characteristics of the economic model are public).

Appearance (Text, Some Graphics, 2D, 3D)

As graphics technology improves, the appearance of games becomes increasingly realistic. The cost of high level virtual reality graphics is considerable, and, often, serious games developers cannot afford them. Nonetheless, as a proxy for investments in the games and as a measure of the reactivity of BGs developers to technological advancements, it is interesting to classify BGs according to their graphical characteristics. Moreover, Prensky (2007) suggests that Digital Natives (i.e., modern learners) need multisensory, interactive, and realistic environments in order to become engaged; however, no consensus exists for this conclusion (Clark & Choi, 2005). In WIN WIN MANAGER, players write text, but some graphics are provided as a feedback to them at the end of each level, then we classify it in the class *Some Graphics*. WHO WANTS TO BE A CEO? (2006) is characterized by 2D graphics. We could not find any BG extensively using 3D animations.

User Interface (Browser Based, Mobile Based, Software Based, Not Digital)

Most digital BGs can be played either by starting an application (Software Based) or by surfing a structured webpage (Browser Based). In addition, we recently found some BGs that are playable on a mobile phone (Mobile Based). Finally, *live* BGs may not need any digital support at all (Not digital). In live BGs, players interact face-to-face, usually under the supervision of instructors, who take note of their choices and behavior. Subsequently, instructors collect the data from all groups and draw conclusions from them, or use them to set up the next turn.

It will certainly be interesting to monitor the cutting-edge trend in this element of the taxonomy. For example, WIN WIN MANAGER needs a browser to be played, ICE CREAM EMPIRE (2006) has been developed specifically to be played by mobile phones, and GLOBAL MANAGEMENT CHALLENGE needs Microsoft Office Excel and additional software to submit the decisions. Most face-to-face games or paper-based experiential exercises such as Miles and Randolph's THE ORGANIZATION GAME (1979) have no digital interface, while in some cases instructors may use spreadsheets and other software to collect data and calculate the score.

Savability (Unlimited, Conditional, None)

A player might be given an opportunity to stop playing and resume the game later. Such opportunities can be unlimited (you can stop and save whenever you want) or conditional (you can stop playing only under certain conditions). Finally, a player might not be able to stop the game before it is finished (e.g., live, face-to-face BGs). In *Synchronous* BGs, *Savability* is not allowed by construction. In most BGs, such as CAPSTONE, players are free to make their calculations, but they must submit their decisions before specific deadlines, not being free to resume the game whenever they want (Conditional Savability).

Virtual Space (Perspective: Omnipresent, Vagrant; Positioning: Absolute, Relative; Environment Dynamics: Free, Fixed, None)

Virtual Space refers to the BG's display space. Elverdam and Aarseth (2007) described it as follows:

> Perspective describes whether the player has a complete overall view of the game space (omnipresent) or if the avatar (or game tokens) must be moved strategically (vagrant). Positioning describes whether the player can discern his or her position exactly as the game rules dictate it (absolute) or if he or she must relate to other objects to decide his or her position (relative). Environment dynamics describes whether the player is allowed to make additions or alterations to the game space (free) or if such alterations only alter the status of predetermined locations (fixed) or finally if no changes to the game space are possible (none). (p. 7)

Most BGs are not characterized by a sophisticated virtual space with avatars representing players: BGs with *Text* or *Some graphics. Appearance* can be conventionally characterized by *Omnipresent Perspective*, because exploring the interface does not provide any strategic advantage and *Absolute Positioning*, because no avatar exists to be positioned relative to other objects. Some BGs allow *Fixed* alterations of the *Environment Dynamics*, because, as the players make their choices (among a finite and fixed set of possible choices), something in the virtual space changes. Other BGs do not allow any change in the *Environment Dynamics*, for example, in WHO WANTS TO BE A CEO? the player answers questions and is rewarded if the answers are correct, but his or her answers do not change the environment. Moreover, in the same game, even though the player's avatar can move in rooms, its path does not seem to provide any strategic advantage to the player, then *Perspective* can be considered *Omnipresent* and *Positioning* is *Absolute*. We did not find any BG with *Vagrant Perspective, Relative Positioning*, and *Free Environment Dynamics*; however, we expect that in the future BGs will begin to resemble contemporaneous amusement games; then these categories will be useful to explore trends.

Target Groups, Goal Objectives, and Feedback

The third category of the taxonomy focuses on the users targeted, the goals of the simulation and the feedback provided to players as well as debriefing of players' performances.

Width of Target (Special Target Group/Topic, Open)

Some BGs such as BUSINESSGAME.BE are developed for a generic audience and do not require any specific cultural background from the players (Open). A large body of BGs is focused on specific topics, such as marketing and project management (e.g., IMPACT5 is focused on leadership), as well as special target groups (e.g., THE GLOBAL BUSINESS GAME is designed for undergraduate and graduate strategic management and international business courses).

Goals Regarding Users (Teaching, Evaluation, Research)

Following the definition of a BG provided earlier, a business game could teach the players (Teaching) and/or evaluate them (Evaluation). In addition, sometimes research institutions use BGs to study the behavior of the players (Research). For example, WIN WIN MANAGER is currently used to improve players' negotiation skills, to evaluate their performances, and to study their behavior with scientific purposes (Greco & Murgia, 2007).

Didactic Goals (Soft Skills, Conceptual Skills, Hard Skills)

Sukumar, Sudhir, and Lucille (2007) argue that business school courses should be designed "to ensure that students acquire the essential managerial skills identified by

Table 2. Katz's (1974) Three Categories of Managerial Skills.

Examples	Soft (human) skills	Conceptual skills	Hard (technical) skills
Of skill	Communication skills, leadership, empathy	Holistic comprehension of the enterprise environment, reciprocal influences of the processes	Project management, logistics management, specific knowledge of processes or products
Of BG	IMPACT5	THE GLOBAL BUSINESS GAME	THE LOGISTIC GAME (2007)

Katz (1974) namely, conceptual, human, and technical" (p. 817). In fact, BGs are often considered as courses themselves within didactic programs. Thus, we conclude that BGs indeed can improve the following categories of skills: Soft skills, Conceptual skills, and Hard skills. Table 2 provides some examples within each of the three categories.

Struggle (Challenge: Identical, Instance, Agent; Goals: Absolute, Relative)

The metacategory *Struggle* presented by Elverdam and Aarseth (2007) contains two dimensions: Challenge and Goals.

Challenge (identical, instance, agent). Elverdam and Aarseth (2007) describe *Challenge* as the three principal ways a game can provide opposition:

> It can come in the form of predefined challenges, which are exactly the same each time the game is played (identical). It can come from a predefined framework that is varied by mathematical randomness (instance). Finally, opposition can come from game agents whose actions are autonomous (agent). (p. 13)

In THE NEGOTIATOR, the players can negotiate with a character by choosing among predefined sentences; such sentences do not change from one player to another, neither the counterpart's reactions change, nor the sequence in which predefined sentences appear: Thus, it can be classified as *Identical*. In WHO WANTS TO BE A CEO? players can build their career by answering questions during their exploration of spaces; answers are chosen randomly from a database, and may change from one player to another, so the game can be classified as *Instance*. In WIN WIN MANAGER, the player's counterpart is human himself or herself too. Thus, his or her reactions are unpredictable, therefore we can classify the BG as *Agent*. Similar considerations can be made for all BGs where teams of players compete together, influencing a virtual market in unpredictable ways, which are different each time the game is played (such as CAPSTONE and THE GLOBAL BUSINESS GAME).

Goals (absolute, relative). Elverdam and Aarseth (2007) states,

> Goals describe if the game has an exact and unchanging victory conditions (absolute) or if the goals are subjective to the unique occurrences in a specific game or the players' interpretations (relative). (p. 14)

In WIN WIN MANAGER, in each scenario, for each player, scores are in the range of 0 to 200, then WIN WIN MANAGER can be classified as *Absolute* in goals. In THE BUSINESS GAME, teams compete in separate tournaments, and are ranked according to a score that depends on market share and profitability. Nevertheless, market share and profitability depend on the strategic choices of teams in the tournament, so Team "1" in Tournament "A" may win with 700 points, as Team "9" in Tournament "B" may win with 100 points. Thus, THE BUSINESS GAME can be classified as *Relative* in goals.

Debriefing (Collective, Individual, Absent)

Debriefing is a well-known and crucial element in game-based learning (Lederman & Kato, 1995) because it links the gaming experience with learning.

> Debriefing provides the opportunity for learners to consolidate their experience and assess the value of the knowledge they have obtained in terms of its theoretical and practical application to situations that exist in reality. (Connolly, Stansfield, & McLellan, 2006, p. 105)

> In addition to the gaming session there needs to be a de-briefing session that helps the participants to mature or develop what they have learned. (Lainema & Nurmi, 2006, p. 113)

Unfortunately, as debriefing can be expensive, many BGs simply do not provide it. However, when present, it is often provided collectively to a class or to a team (Collective). Alternatively (and much less frequently), it is provided individually (Individual). For example, WIN WIN MANAGER's staff can provide both collective and individual debriefing to players about their negotiation behavior.

Feedback (Absent, Immediate, Final)

Garris, Ahlers, and Driskell (2002) stipulate, "Individual judgments and behavior are regulated by comparisons of feedback to standards or goals" (p. 454). As a mechanism for positive and negative reinforcement, feedback supports learning and influences the performances and motivations of the players. Feedback can be provided immediately following a player's decision (Immediate) or at the end of the game (Final). It has been shown that frequent and immediate feedback benefits practice performance, but it can undermine learning with respect to task transfer (Goodman, 1998). On the other hand, feedback interventions that offer less frequent and delayed feedback can lead to poorer practice performance, but better learning (Schooler & Anderson, 1990). WIN WIN

MANAGER provides an automated feedback to the player when both negotiators send to the system the output of their negotiation, so it can be classified as *Immediate* in *Feedback*. In THE BUSINESS GAME, while players are filling in the fields with their decisions for the next quarter, an algorithm provides decision-editing routines that inform the players whether their decisions are reasonable or not; also in this case, we can classify this type of *Feedback* as *Immediate*. In MILLENIUM AIRLINES (2008), players set the plans of their airlines in order to achieve their strategies. As the quarters pass by, they gain little information about the output of their decisions (such as stock prices), whereas, at the end of the game, many pieces of information are disclosed as feedback to the players, so it can be classified *Final* in feedback.

Feedback Degree (Complete, Incomplete)

This element reflects the level of specificity of the feedback provided. If the specificity of the feedback is very high, the player has been given important information about his or her own behavior (Complete). Otherwise, the information is not very specific (Incomplete). A recent study of Goodman and Wood (2004) shows that "varying feedback specificity creates conditions for learning different aspects of a task, partially through its impact on learning opportunities during practice" (p. 250). For example, in WIN WIN MANAGER, automatic feedback is focused on specific provisions included in the contract submitted at the end of the negotiation, but it does not provide information about the player's conduction of the negotiation, being in this sense *Incomplete*. On the other hand, instructor's feedback during debriefings can be very detailed, because it derives from the analysis of the conversations. Therefore, WIN WIN MANAGER provides, through its two feedback mechanisms, both *Complete* and *Incomplete* feedback. In this case, we would have classified the BG in both the dimensions, because instructor's debriefing is an add-on to the standard version of the game.

User Relation/Community

The fourth dimension of the taxonomy describes several characteristics of the interaction among users. Even though *User Relation/Community* is a novel dimension that has no reference to past taxonomies, one of the elements within it, *Players Composition*, represents an evolution of Maier and Größler's *Number of users* category.

Interactions Among Players (Direct, Indirect, Absent)

One player's actions might directly influence other players' decisions or performances (e.g., a player might sell something to another, or players within the same team can interact to choose their strategy for the next turn) or they may influence indirectly (e.g., the strategic choices of a team might change the market equilibrium lowering the share indexes of other teams' virtual companies). Moreover, the interaction and the information sharing among players could be designed in the game itself (formal interaction) or players can interact in an informal way (De Toni & Nonino, 2010). For

example, in CAPSTONE, each player interacts both directly (to make the decisions within the team) and indirectly (as different teams can only submit their decisions to a central black box where they interact according to unknown algorithms). Of course, in single player BGs, players do not interact with others.

Player Composition (Single Player, Single Team, Two Players, Two Teams, Multiplayer, Multiteam, Massive)

Player Composition describes how the players in a game are organized (Elverdam & Aarseth, 2007). The Player Composition stresses different aspects of learning. *Single player* mode can be useful to teach specific topics (e.g., EXPORT GAME, 2002, helps the player to improve his or her skill in the internationalization of his or her company); *Single team* and *Multiteam* modes may improve players' attitude to cooperate and organize work in groups (e.g., in THE GLOBAL BUSINESS GAME, participants can work in teams competing against others' companies); *Two players* and *Multiplayer* modes are useful to improve interpersonal skills (e.g., in WIN WIN MANAGER, players negotiate one with another to improve their negotiation skills); and finally, in *Massive* mode, both interpersonal and team-working skills may be improved, because players may be free to form groups and coalitions (e.g., in AIRWAY SIM, players can set up airline alliances).

Player Relation (Bond: Dynamic, Static; Evaluation: Individual, Team, Both)

As defined by Elverdam and Aarseth (2007),

> Bond describes whether the relation between players can change during play (dynamic) or not (static) . . . Evaluation describes how the players or the outcome of the game is quantified. The individual player can be evaluated (individual), the players can be evaluated as a team (team), or they can be evaluated both as a team and as individual players (both). (p. 12)

In WIN WIN MANAGER, players change roles and counterparts after each level, then the *Bond* is *Dynamic*; each player is given a score accordingly to his or her own performance, then the *Evaluation* is *Individual.* In THE BUSINESS GAME, each team competes with the others and this structure does not change during the course of play, making the *Bond Static*; moreover, the team performance is evaluated through price/quality ratio and other measures, then the *Evaluation* is *Team*.

Role-Playing (Yes, No)

A role-playing game (RPG) is defined as,

> [a] game where each player takes on the role of a character. The character's story takes shape and evolves depending on the player's decisions and choices. Role playing implies a complex

> interaction among the players (social interaction) or among a player and computer-controlled characters. (Greco, 2009, p. 159)

The use of role-playing in a game can significantly increase a player's engagement (Wishart, Oades, & Morris, 2007), which is considered an important enhancer of the learning experience (Brisson & Luckner, 1996). That said, Graham and Gray (1969) argue that "in one sense all gaming involves role playing" (p. 18). Thus, this is a highly ambiguous element, as different evaluators could label the same business game differently. We suggest equating a BG with a *role-playing game* when players must identify themselves with their assigned role in order to be successful in the game or to consolidate the learning. To clarify the difference, consider the two following examples. In WIN WIN MANAGER, players are explicitly asked to identify themselves fully with their assigned role; they are asked to feel the characters' background and the consequences that a bad agreement would have on their future, and to write their messages as if they were the character. Such behavior is functional to the effectiveness of the game. On the other hand, in THE BUSINESS GAME, players have to run a virtual enterprise, but they do not need to feel and behave as if they were the Marketing Director, or the CEO of the company, although such behavior might increase fun and improve their performance. Even when players assign themselves a role (or are assigned to it by the instructor), it is infrequent that they will interact within their team as if they really were sitting in the meeting room of an enterprise, being on first name terms.

Players' Community (Present, Absent)

The most popular amusement games result in online communities where players socialize and share knowledge about the game. Sharing is not necessarily a collusive behavior. For example, in THE BUSINESS GAME, players are encouraged to share their thoughts and questions on the Facebook page of the game, although they are not allowed to disclose details about the simulation until the competition is over. The emergence of a player community is often understood as a measure of the level of engagement provided by the game. Bruckman (1998) found that, in the case of virtual reality environments for constructionist learning, the community supports for such learning were more important than the environment itself.

Developers' Community (Present, Absent)

The open-source movement has resulted in numerous communities of developers cooperating with one another, without being paid, in an effort to improve operating systems (e.g., Linux), applications (e.g., Mozilla Firefox), and web resources (e.g., Moodle). The existence of such a community for BGs could result in a significantly accelerated rate of innovation. We have seen no evidence of stable developers' communities focused on a specific BG.

Alliances (Foreseen, Not Foreseen, Not Present)

Alliances among competitors in a game can improve the knowledge sharing associated with the *Players' Communities* mentioned earlier. In fact, members of an alliance tend to pursue a shared goal and tend to be more motivated to cooperate than do members of a community of players who are competing with each other to win. Often, the structure of a game does not allow the formation of alliances (*Not Present*). On occasion, even if developers did not include an alliance formation mechanism into the game, they can nonetheless arise spontaneously, in some cases unauthorized by the developers and/or instructors (*Not Foreseen*). On the other hand, developers may consider the formation of alliances as an integral and desirable part of the BG (*Foreseen*). For example, in THE GLOBAL BUSINESS GAME, "teams can negotiate joint-venture arrangements and strategic alliances through patent licensing, subcontracts and the sale and transfer of production capacity" (http://onlinegbg.com/gbw-details.php), thus *Alliances* are *Foreseen*.

Model

This category aims to examine how the logical and dynamic models within the BG work. Some of the elements chosen by Maier and Größler (*Structure, Proceeding of Time in Simulation Engine, Role of Simulation Model*, and *Domain of Variables*) have been discarded because they are of little or no interest for the comprehension of a BG. Moreover, their values cannot be estimated without an in-depth knowledge of the model underlying the BG. The *Real-World Domain* element has been modified because all the targets of our analysis focus on business, yet we maintained a distinction between businesses set in a realistic, contemporaneous world, or not.

Domain (Realistic, Fantasy)

This element describes whether the game setting is realistic or fantastic. It is important to point out that many BGs are set within virtual companies that do not exist in reality. Nonetheless, such games are tagged as *Realistic* when those virtual companies are at least similar to real ones or must act like real ones if they are to be economically successful. On the other hand, games set in the past (e.g., management of railroad companies in the 19th century) or in the future (e.g., management of mining companies on the moon) are tagged as *Fantasy*. A fantasy domain might help students to abstract the more significant elements in their analyses, but the effects of a simulation that occur in a realistic domain are likely to be considered more truthful.

Behavior (Deterministic, Stochastic)

This element explores the behavior of the model. Games are usually developed to react deterministically to a player's decisions. From a didactic perspective, this allows the instruction to stress concepts associated with the *correct way to do something*. If the

player makes a good decision, the system rewards him or her (*Deterministic*). In this case, a player may predict the output of the simulation exactly and understand both the rules and the patterns of the economic system. In WHO WANTS TO BE A CEO? players have to answer specific questions, and the correctness of their answers does not vary according to any random variable.

In other cases, the main purpose of the developer is to simulate an environment realistically. Thus, negative events can happen even if a player made the correct decision or, on the other hand, a series of lucky events can support a player whose strategy was otherwise incorrect (*Stochastic*); in this case, the learning process focuses on the impossibility of predicting exactly subsequent stages in a game and helps the player to realize how the real world works. For example, in THE BUSINESS GAME, the market's overall demand varies according to periodicities, trends, and random events.

Generality of Model in Regard to Domain (Special Area of Interest, Whole Domain)

Generality of Model in Regard to Domain describes whether the BG simulates the management of a company in many of its characteristics such as marketing, finance, and R&D (e.g., CAPSTONE), or whether it focuses on specific topics (e.g., WIN WIN MANAGER focuses specifically on negotiation).

Influence of External Data (With Such Influence, Without Such Influence)

Most the BGs that we have been able to analyze are characterized by data specific to their virtual environments, and are not influenced by external data. However, some of them include external data, such as real euro/dollar exchange ratio, inflation ratio, and so on. For example, TEMPOMATIC IV (Scott, & Strickland, 1974) draws on the Business Week Index to tie the game to fluctuations in the real-world economy (Keys & Biggs, 1990). This approach may increase both the realism of the simulations and the interest of players for contemporaneous economical and financial news.

Configurability of the Model (Absent, Mixed, High)

The configurability of the model describes to what extent the BGs' underlying model can be adapted to the specific needs and aims of the instructor. According to Hiltunen (1998), the configurability of a system can be accomplished with three elements: design goals, links within the system, and modifications of the user interface. By referring only to the model, several aspects of a BG can be modified: the user decisions, the feedback system, and the business environment. For the user, changing the model means adopting different learning goals. We define High Configurability as a situation in which most aspects can be changed. In THE BUSINESS GAME, the instructor can choose the number of teams, the number of quarters, the number of

markets, special events happening during the game (such as strikes and demand dynamics), the number of strategic levers, and many other parameters of the game, thus in this case we consider *High Configurability of the model*. When only a small amount of the variables can be changed according to the instructor's directions, we consider the *Configurability of the model* as *Mixed*. Nonetheless, most models are not configurable at all (*Absent*).

Fidelity (High, Medium, Low)

Alexander, Brunyé, Sidman, and Weil (2005) defined fidelity as, "the extent to which the virtual environment emulates the real world." The fidelity of a game is strongly related to a model's behavior, as the presence of stochastic behavior can be considered an element of realism. Often, graphics are considered important to augmenting the realism of a simulation.

The importance of *verisimilitude* and *plausibility* in a simulation model has been described previously by Kibbee (1961) and Boocock (1972). Similarly, Sutcliffe (2002) stipulates, "If students regard a simulation as 'unrealistic,' they are unlikely to regard its predictions as relevant to their understanding of the real world" (p. 22). Indeed, in this situation, learning goals are missed. Nonetheless, players might consider *unrealistic* a high-fidelity game just because they do not get the results they wanted from their decisions.

We have defined fidelity as a weighted sum of several other elements in our taxonomy, in order to measure it in an objective way, although this might increase the redundancy of our model. Nevertheless, this indicator provides new and important information about the business game. Starting from the above theories and employing six elements (along with the corresponding weights), we are able to obtain a clear definition and determination of fidelity:

- *Behavior* (Deterministic, 1; Stochastic, 6). High-fidelity BGs should be able to simulate the uncertainties of reality; the introduction of random variables may achieve this aim.
- *Interaction* (Direct, 6; Indirect, 3.5; Absent, 1). Indirect interactions need an engine to compute data provided separately by the players; such an engine needs to simplify the matching process of such data, while direct interactions among players may turn in a more complex and indeed more realistic behavior.
- *Player Composition* (Single Player, 1; Single Team, 1; Two Player, 2; Two Team, 3; Multiplayer, 4; Multiteam, 5; Massive, 6). The more players are involved in the BGs, the more complex may be their interactions (e.g., with the formation of coalitions).
- *Challenge* (Identical, 1; Instance, 3.5; Agent, 6). The higher the level of opposition provided by the BG, the higher will be the realism of the simulation.
- *Didactic Goals* (Soft Skills, 3.5; Conceptual Skills, 1; Hard Skills, 6). The development of conceptual skills may tolerate a simplified environment (e.g., if

the game is supposed to provide a broad comprehension of an enterprise, some details such as product packaging, negotiations with Union, and the appearance of the company webpage can be omitted). The development of soft skills will need specific details to be introduced in the scenario (e.g., in a negotiation, game players should be given specific information about their alternatives, counterparts, etc.). Finally, hard skills need very specific and detailed information that should match those of the real world (e.g., if the game is supposed to teach specifically logistics management, all the relevant variables should be included in the simulation).

- *Appearance* (3D, 6; 2D, 4; Some Graphics, 2; Text, 1).

Thus, we have an upper limit of 36 points and a lower limit of 6 points within which we define the different levels of fidelity:

- *High Fidelity*, when the score is higher than 27 ($27 \leq X \leq 36$)
- *Medium Fidelity*, when the score falls between 17 and 26 ($17 \leq X \leq 26$)
- *Low Fidelity*, when the score is less than 16 ($6 \leq X \leq 16$)

Conclusions, Limits, and Future Research Directions

We believe that our research represents an accurate synopsis of what is otherwise heterogeneous literature about BGs. We answered our first research question through a novel definition of *business game* that focuses on the goals of each game, rather than on its technical characteristics. Then we answered our second research question by means of a taxonomy based on the literature from both game-based learning and management. The taxonomy presented in this article consists of close to 40 elements, and although this is a relatively large number, we believe it is the minimum necessary for a comprehensive description of a business game. Table 3 shows an application of our taxonomy to five different BGs cited in this article. Table 3 has been compiled by three different respondents who had developed a game, and/or played it, and/or read scientific or informative articles about it. The matching of the three respondents' answers did not show any incompatibility, while developers provided additional information (e.g., players of the online versions of WIN WIN MANAGER and THE BUSINESS GAME were not aware of their *Face-to-Face* editions).

Our taxonomy, based on the principal classifications represented in the literature, could be refined further through an in-depth analysis of the state of the art of the BG industry (both past and present), and which could raise the need for additional categories. Our future research will be directed at overcoming this limitation by an effort to categorize the totality of BGs used in learning (or at least a major part of them). In fact, the taxonomy we have proposed was guided by one main objective: to understand the current state of the art and describe its evolutionary path by comparing the very first business games created with contemporaneous ones. Table 3 showed an interesting comparison among THE TOP MANAGEMENT DECISION SIMULATION and four other contemporaneous BGs.

Table 3. An Application of the Taxonomy to Five BGs.

			WIN WIN MANAGER	THE BUSINESS GAME	WHO WANTS TO BE A CEO?	CAPSTONE	TOP MANAGEMENT DECISION SIMULATION
1. Environment of application	a. Degree of integration	i. Stand-alone simulation	x	x	x	X	x
		ii. Integration in learning environment					
	b. Environment	i. Computer network	x	x	x	X	
		ii. Face to face	x	x		X	x
		iii. Other					x
	c. Representation	i. Mimetic			x		
		ii. Arbitrary	x	x		X	x
	d. Teleology	i. Finite	x	x	x	X	x
		ii. Infinite					
	e. Use of teachers/ facilitators/coaches	i. Totally self-controlled learning	x	x	x	x	
		ii. Support by teacher/ facilitator/coach					x
2. Design elements of user interface	a. Chance of intervention while simulating	i. Discrete periods	x	x		X	x
		ii. Simulation in one run					
		iii. Continuous			x		
	b. Sequentiality	i. Strict Sequentiality		x		x	x
		ii. Explorative	x		x		
	c. Characteristics of users' decisions	i. Qualitative	x		x		
		ii. Quantitative	x	x		x	x

(continued)

Table 3. (continued)

		WIN WIN MANAGER	THE BUSINESS GAME	WHO WANTS TO BE A CEO?	CAPSTONE	TOP MANAGEMENT DECISION SIMULATION
d. Internal time						
i. Haste	1. Present					
	2. Absent	x	x	x	x	x
ii. Synchronicity	1. Present		x		x	x
	2. Absent	x		x		
iii. Advancing of time in user interface	1. Self-proceeding		x		x	x
	2. User-driven	x		x		
e. Transparency of simulation model	i. Black box	x		x	x	x
	ii. Gray box		x			
	iii. Transparent box					
f. Appearance	i. Text					x
	ii. Some graphics	x	x		x	
	iii. 2D			x		
	iv. 3D					
g. User interface	i. Browser based	x	x	x	x	
	ii. Mobile based					
	iii. Software based			x		x
	iv. Not digital					

(continued)

Table 3. (continued)

			WIN WIN MANAGER	THE BUSINESS GAME	WHO WANTS TO BE A CEO?	CAPSTONE	TOP MANAGEMENT DECISION SIMULATION
3. Target groups, goal objectives, and feedback	h. Savability	i. Unlimited					
		ii. Conditional	x	x		x	x
		iii. None			x		
	j. Virtual space						
	i. Perspective	1. Omnipresent	x	x		x	x
		2. Vagrant					
	ii. Positioning	1. Absolute	x	x	x	x	x
		2. Relative					
	iii. Environment dynamics	1. Free					
		2. Fixed	x	x		x	x
		3. None			x		
	a. Width of target group	i. Special target group			x	x	x
		ii. Open	x	x			
	b. Goals regarding users	i. Teaching	x	x	x	x	x
		ii. Evaluation	x	x		x	x
		iii. Research	x				
	c. Didactic goals	i. Soft skills	x		x		
		ii. Conceptual skills		x		x	x
		iii. Hard Skills					
	d. Struggle						

(continued)

Table 3. (continued)

		WIN WIN MANAGER	THE BUSINESS GAME	WHO WANTS TO BE A CEO?	CAPSTONE	TOP MANAGEMENT DECISION SIMULATION
i. Challenge	1. Identical			x		
	2. Instance					
	3. Agent	x	x		x	x
ii. Goals	1. Absolute	x		x		x
	2. Relative		x		x	
e. Debriefing	i. Collective	x	x		x	x
	ii. Individual	x				
	iii. Absent			x		
f. Feedback	i. Absent					
	ii. Immediate	x	x	x	x	x
	iii. Final					x
g. Feedback degree	i. Complete	x	x		x	x
	ii. Incomplete	x	x	x	x	x
a. Interactions among players	i. Direct	x	x		x	x
	ii. Indirect		x		x	x
	iii. Absent			x		

(continued)

Table 3. (continued)

			WIN WIN MANAGER	THE BUSINESS GAME	WHO WANTS TO BE A CEO?	CAPSTONE	TOP MANAGEMENT DECISION SIMULATION
4. User relation/ community	b. Player composition	i. Single person			x		
		ii. Single team					
		iii. Two player					
		iv. Two team					
		v. Multiplayer	x				
		vi. Multiteam		x		x	x
		vii. Massive					
	c. Player relation						
	i. Bond	1. Dynamic	x				
		2. Static		x	x	x	x
	ii. Evaluation	1. Individual	x		x		
		2. Team		x		x	x
		3. Both					
	d. Role-playing	i. Yes	x				
		ii. No		x	x	x	x
	e. Players' community	i. Present		x			
		ii. Absent	x		x	x	x
	f. Developers' community	i. Present					
		ii. Absent	x	x	x	x	x
	g. Alliances	i. Foreseen					
		ii. Not foreseen					
		iii. Not present	x	x	x	x	x

(continued)

Table 3. (continued)

			WIN WIN MANAGER	THE BUSINESS GAME	WHO WANTS TO BE A CEO?	CAPSTONE	TOP MANAGEMENT DECISION SIMULATION
5. Model	a. Domain	i. Realistic	x	x	x	x	x
		ii. Fantasy					
	b. Behavior	i. Deterministic	x		x		
		ii. Stochastic		x		x	x
	c. Generality of model in regard to domain	i. Special area of interest	x		x		
		ii. Whole domain		x		x	x
	d. Influence of external data	i. With such influences					
		ii. Without such influences	x	x	x	x	x
	e. Configurability of the model	i. Absent			x		x
		ii. Average	x			x	
		iii. High		x			
	f. Fidelity	i. High		x (29.5)		x (29.5)	x (28.5)
		ii. Medium	x (22.5)				
		iii. Low			x (13)		x

Note. A quantitative estimation of fidelity is enclosed in parenthesis in the corresponding cells of the element 5.f.

Table 4. Reviews of BGs.

Number of BGs Reviewed	References
More than 100	Kibbee, Craft, and Nanus (1961)
183	Graham and Gray (1969)
More than 300	Zuckerman and Horn (1971)
228	Horn and Cleaves (1980)
354	Elgood (1997)

Several scholars in the past have provided descriptions of BGs (Table 4).

However, Elgood's (1997) assessment of the (then current) number of BGs was the most recent we could find. We suggest that a single research group cannot build a complete list of the BGs. In fact, information about nondigital BGs is difficult to find, especially if the games were developed before the 1990s. In addition, many BGs are not developed in English and are poorly optimized for search engines. Finally, the compilation of Table 3 showed that playing a BG or reading about it was not sufficient to identify properly all its characteristics; in which case, the cooperation of developers is needed. Thus, in our opinion, in order to obtain a large and reliable database of BGs, a collaborative approach involving the entirety of the scientific and development communities will be required. Such collaborative approach may enhance the creation of communities of innovation (Grimaldi, Cricelli, & Rogo, 2012), improving the existing BGs and creating new ones in a knowledge-creation perspective (Cricelli & Grimaldi, 2008).

Our five-part taxonomy will be used to develop an international and open database. Such a database will allow for the identification of meaningful trends in the development of BGs. Moreover, it will become a worldwide showcase for business games, and it will be capable of supporting the focused research needs of business schools and managers alike.

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Two of the authors of the article, Nicola Baldissin and Fabio Nonino, are partners of "The business game S.r.l.," which owns one of the games, THE BUSINESS GAME, reviewed in this article.

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References

Aarseth, E., Smedstad, S., & Sunnanå, L. (2003, November). *A multidimensional typology of games*. Level Up Conference Proceedings, University of Utrecht, Netherlands (pp. 48-53).

AIRWAY SIM. (2006). Vantaa: Finland. AviaDesign Ky.

Alexander, A., Brunyé, T., Sidman, J., & Weil, S. (2005). From gaming to training: A review of studies on fidelity, immersion, presence, and buy-in and their effects on transfer in pc-based simulations and games. *The Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC)*. Orlando, FL. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.103.3657&;rep=rep1&type=pdf

Anderson, P. H., & Lawton, L. (2009). Business simulations and cognitive learning. *Simulation & Gaming*, *40*, 193-216.

Baldissin, N., De Toni, A. F., & Nonino, F. (2007, September 9-16). *Evolution of the management games: Towards the massive multiplayer online role playing game?* International Conference Learning with Games. Sophia Antipolis, France (pp. 24-26).

Battini, D., Faccio, M., Persona, A., & Sgarbossa, F. (2007, July-August). *THE LOGISTIC GAME*. Proceedings of the 25th International Conference of the System Dynamics Society and 50th Anniversary Celebration.

Boocock, S. S. (1972). Validity-testing of an intergenerational relations game. *Simulation & Gaming*, *3*, 29-40.

Brisson, C., & Luckner, J. (1996). Fun in learning: The pedagogical role of fun in adventure education perspectives. *Journal of Experiential Education*, *19*, 108-112.

Bruckman, A. (1998). Community support for constructionist learning. *Computer Supported Cooperative Work*, *7*, 47-86.

BUSINESSGAME.BE. (2007). [Developed by Lesire, G.] Brasschaat: Belgium. Lesire, G.

CAPSTONE. (2004). [Developed by D. Smith.] Northfield: IL. Capsim Management Simulations Inc.

Carson, J. R. (1969). Business games: A technique for teaching decision making. In R. G. Graham & C. F. Gray (Eds.), *Business games handbook*. New York, NY: American Management Association.

Chapman, G. M., & Martin, J. F. (1995). Computerized business games in engineering education. *Computer Education*, *25*, 67-73.

Clark, R., & Choi, S. (2005). Five design principles for experiments on the effects of animated pedagogical agents. *Journal of Educational Computing Research*, *32*, 209-225.

Connolly, T., Stansfield, M., & McLellan, E. (2006). Using an online games-based learning approach to teach database design concepts. *The Electronic Journal of e-Learning*, *4*, 103-110.

Cricelli, L., & Grimaldi, M. (2008). A dynamic view of knowledge and information: A stock and flow based methodology. *International Journal of Management and Decision Making*, *9*, 686-698.

De Toni, A. F., & Nonino, F. (2010). The key roles in the informal organization: A network analysis perspective. *The Learning Organization*, *17*, 86-103.

DOOM. (1993). Mesquite: TX. id Software.

Eilon, S. (1963). Management games. *Operational Research*, *14*, 137-149.

Elgood, C. (1997). *Handbook of management games and simulation* (6th ed.). Aldershot, UK: Grower Publishing.

Elverdam, C., & Aarseth, E. (2007). Game classification and game design: Construction through critical analysis. *Games and Culture*, *2*, 3-22.

ENTERPRISE EUROPEAN BUSINESS GAME. (2009). [Developed by Gambi, A.] Ravenna: Italy. CNA Ravenna.

EXPORT GAME. (2002). [Developed by Ecohmedia.] Roma: Italy. Istituto Nazionale per il Commercio Estero.

Faria, A. J. (1987). A survey of the use of business games in academia and business. *Simulation & Gaming*, *18*, 207-224.

Faria, A. J. (1998). Business simulation games: Current usage levels—An update. *Simulation & Gaming*, *29*, 295-308.

Garris, R., Ahlers, R., & Driskell, J. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming*, *33*, 441-467.

Goodman, J. (1998). The interactive effects of task and external feedback on practice performance and learning. *Organizational Behavior and Human Decision Processes*, *76*, 223-252.

Goodman, J., & Wood, R. E. (2004). Feedback specificity, learning opportunities, and learning. *Journal of Applied Psychology*, *89*, 809-821.

Gosen, J., & Washbush, J. (2004). A review of scholarship on assessing experiential learning effectiveness. *Simulation & Gaming*, *35*, 270-293.

Graham, R., & Gray, C. (1969). *Business games handbook*. New York, NY: American Management Association.

Greco, M. (2009). The use of role–playing in learning. In T. Connolly, M. Stansfield, & L. Boyle (Eds.), *Games-based learning advancements for multi-sensory human computer interfaces: Techniques and effective practices* (pp. 157-173). Hershey, PA: Information Science Reference.

Greco, M., Branca, A. M., & Morena, G. (2011). An experimental study of the reputation mechanism in a business game. *Simulation & Gaming*, *42*, 27-42.

Greco, M., & Murgia, G. (2007). *Improving negotiation skills through an online business game*. Proceedings of the European Conference on Game Based Learning. Paisley, UK (pp. 97-104).

Grimaldi, M., Cricelli, L., & Rogo, F. (2012). A methodology to assess value creation in communities of innovation. *Journal of Intellectual Capital*, *13*, 305-330.

Hiltunen, M. A. (1998). Configuration management for highly customizable software. In Proceedings: Fourth international conference on configurable distributed systems (pp. 197-205). Los Alamitos, CA: IEEE Computer Society.

Horn, R., & Cleaves, A. (1980). *The guide to simulation/games for education and training*. Beverly Hills, CA: SAGE.

Hubble, M. W., Richards, M. E., & Wilfong, D. (2011). Teaching emergency medical services management skills using a computer simulation exercise. *Simulation in Healthcare*, *6*, 25-33.

ICE CREAM EMPIRE. (2006). Milan: Italy. Bocconi University.

IMPACT5. (2002). St. Petersburg: FL. Paradigm Learning

Katz, R. L. (1974). Skills of an effective administrator. *Harvard Business Review*, *52*, 90-102.

Keys, J. B., & Biggs, W. D. (1990). A review of business games. In J. W. Gentry (Ed.), *Guide to business gaming and experiential learning* (pp. 48-73). London, England: Nichols/GP.

Keys, J. B., Fulmer, R. M., & Stumpf, S. A. (1996). Microworlds and Simuworlds: Practice fields for the learning organization. *Organizational Dynamics*, *24*, 36-49.

Khalifa, M., & Lam, R. (2002). Web-based learning: Effects on learning process and outcome. *IEEE Transactions on Education*, *45*, 350-356.

Kibbee, J. M. (1961). Model building for management games. In A. Newgarden (Ed.), *Simulation and gaming: A symposium* (pp. 8-15). New York, NY: American Management Association.

Kibbee, J. M., Craft, C., & Nanus, B. (1961). *Management games*. New York, NY: Reinhold.

Kolb, D. A., & Fry, R. (1975). Towards an applied theory of experiential learning. In C. L. Cooper (Ed.), *Theories of group processes* (pp. 33-58). Chicago, IL: Wiley.

Lainema, T., & Nurmi, S. (2006). Applying an authentic, dynamic learning environment in real world business. *Computer & Education*, *47*, 94-115.

Lane, D. C. (1995). On a resurgence of management simulation and games. *Journal of the Operational Research Society*, *46*, 604-625.

Larreche, J. C. (1987). On simulations in business education and research. *Journal of Business Research*, *15*, 559-571.

Lederman, L. C., & Kato, F. (1995). Debriefing the debriefing process. In D. Crookall & K. Arai (Eds.), *Simulation and gaming across disciplines and cultures: ISAGA at a watershed* (pp. 235-242). Thousand Oaks, CA: SAGE.

Maier, F., & Größler, A. (2000). What are we talking about? A taxonomy of computer simulations to support learning. *System Dynamics Review*, *16*, 135-148.

Meier, R. C., Newell, W. T., & Pazer, H. L. (1969). *Simulation in business and economics*. Englewood Cliffs, NJ: Prentice Hall.

MICROSOFT® FLIGHT SIMULATOR. (2006). [Developed by Microsoft Corporation.] Redmond: WA. Microsoft Game Studios.

MILLENIUM AIRLINES. (2008). Milano: Italy. Management Utilities Srl.

Mitsuhara, H., Ochi, Y., Kanenishi, K., & Yano, Y. (2006). Adaptive link generation for multiperspective thinking on the web: An approach to motivate learners to think. *Innovations in Education & Teaching International*, *43*, 137-149.

MONOPOLOGS. (1955). [Developed by Rand Logistic Department.] Santa Monica: CA. Rand Corporation.

Nissen, V., & Ananidze, G. (2007). *Modelling qualitative information in a management simulation game*. Operation Research Proceedings, Berlin, Germany (pp. 389-394).

OBJECTION! (1992). Shreveport: LA. Transmedia Inc.

OIL BARONS. (1983). San Francisco: CA. Epyx.

Prensky, M. (2007). *Digital game-based learning*. St. Paul, MN: Paragon House.

Rachman-Moore, D., & Kenett, R. (2006). The use of simulation to improve the effectiveness of training in performance management. *Journal of Management Education*, *30*, 455-476.

Randolph, W., & Miles, R. H. (1979). The Organization Game: A behaviorally played simulation. *Journal of Management Education*, *4*(2), 31-35.

Ricciardi, F. M., Craft, C. J., Malcolm, D. G., Bellman, R., Clark, C., Kibbee, J. M. & Rawdon, R. H., (1957). *TOP MANAGEMENT DECISION SIMULATION: The AMA approach*. New York, NY: American Management Association.

Ruohomaki, V. (1995). Viewpoints on learning and education with simulation games. In J. O. Riis (Ed.), *Simulation games and learning in production management* (pp. 14-28). London, England: Chapman & Hall.

Savolainen, T. (1997). Simulation games in CIM and learning organization. *Computers in Industry*, *33*, 217-221.

Schooler, L., & Anderson, J. (1990). *The disruptive potential of immediate feedback*. Proceedings of the 12th Annual Conference of the Cognitive Science Society. Erlbaum, Mahwah (pp. 702-708).

Scott, C. R., & Strickland, A. (1974). *TEMPOMATIC IV: A management simulation*. Boston, MA: Houghton Mifflin.

SID MEIER'S RAILROAD TYCOON. (1990). Alameda: CA. Micropose.

Sukumar, C. D., Sudhir, T., & Lucille, V. P. (2007). Designing business school courses to promote student motivation: An application of the job characteristics model. *Journal of Management Education*, *31*, 812-831.

Sutcliffe, M. (2002). Simulations, games and role-play. In P. Davies (Ed.), *The handbook for economic lecturers* (pp. 1-26). Bristol, UK: The Higher Education Academy Education Network.

THE BUSINESS GAME (V 5.8). (2010). Torreano di Martignacco, Udine: Italy. The Business Game Srl.

THE GLOBAL BUSINESS GAME. (2000). [Developed by J. Wolfe.] Knoxville: TN. Innovative Learning Solutions Inc.

THE NEGOTIATOR. (n.d.). Mumbai: India. Games2win.com.

TOP MANAGEMENT DECISION SIMULATION. (1956). New York: NY. American Management Association.

WHO WANTS TO BE A CEO? (2006). Glen Iris, Victoria: Australia. CEO Online Pty Limited.

WIN WIN MANAGER (v. 3.0). (2009). [Developed by Greco, M., & Patriarca, F.] Sulmona: Italy. WinSet Srl.

Wishart, J., Oades, C., & Morris, M. (2007). Using online role play to teach internet safety awareness. *Computers & Education*, *48*, 460-473.

ZOO TYCOON. (2001). [Developed by Blue Fang Games.] Redmond: WA. Microsoft Game Studios.

Zuckerman, D., & Horn, R. (1971). *The guide to simulations/games for education and training*. Lexington, KY: Information Resources.

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