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ARTÍCULOS ORIGINALES

A business simulation experience for developing professional competences

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págs. **7-21**

ABTRACT Business simulators are formative and educational tools that allow us to transmit contents and foster skills and competencies in business management. in English they are known as *business games*, which at the same time are belong to the category of *serious games*. The aim of this study is to analyze the potential of a business simulator, not just as a formative tool to promote learning, but also to develop skills and abilities. in this sense, the methodology used is based on the analysis of a concrete successful experience in the use of a simulator for formation as a dynamizing element and a catalyst for working on competencies in an e-learning setting. the paper will detail how these competencies can be worked on in each of the decision making stages of the business simulator "Fórmula i". the user has to manage a formula 1 motor-racing team, trying to obtain the best sporting results possible by making a series of strategic and operative decisions. Finally, through a self-designed econometric regression model, the results obtained in the first implementation are analyzed to evaluate the influence of this methodology on the evaluation of competencies management for human resources in companies.

KEYWORDS Business games, competencies evaluation, problem solving, business

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Una experiencia de simulación empresarial para el desarrollo de competencias profesionales

RESUMEN Los simuladores empresariales permiten transmitir contenidos, potenciar habilidades y competencias en gestión empresarial como herramientas formativas y educativas. En inglés son conocidos bajo el nombre de *business games*, los que a su vez son una modalidad de *serious games*. El propósito de este trabajo es analizar la potencialidad de un simulador empresarial como herramienta no solo formativa para promover el aprendizaje, sino también para potenciar capacidades y habilidades. En este sentido, la metodología utilizada se fundamenta en el análisis de una experiencia concreta de éxito en el uso de este simulador para el ámbito formativo como elemento dinamizador y catalizador para trabajar competencias en el entorno *e-learning*. En este análisis se detallará cómo se pueden trabajar dichas competencias en cada una de las fases de toma de decisiones del simulador empresarial llamado "Fórmula i". El usuario debe gestionar una escudería de Fórmula 1 tratando de obtener los mejores resultados deportivos posibles a partir de una serie de decisiones tanto estratégicas como operativas. Finalmente, a través de un modelo econométrico de regresión de elaboración propia, se analizan los resultados obtenidos en su primera puesta en práctica para evaluar la influencia de esta metodología en la evaluación de la gestión de competencias de los recursos humanos en la empresa.

PALABRAS CLAVE *business games*, evaluación competencias, resolución problemas, simulación empresarial.

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Uma experiência de simulação empresarial para o desenvolvimento de competências profissionais

RESUMO Os simuladores empresariais permitem transmitir conteúdos, potenciar habilidades e competências em gestão empresarial como ferramentas formativas e educativas. Em inglês são conhecidos baixo o nome de business games, os que por sua vez são uma modalidade de serious games. O propósito deste trabalho é analisar a potencialidade de um simulador empresarial como ferramenta, não só formativa para promover o aprendizado, mas também para potenciar capacidades e habilidades. Em este sentido, a metodologia utilizada se fundamenta na análise de uma experiência concreta de sucesso no uso deste simulador para o âmbito formativo como elemento dinamizador e catalizador para trabalhar competências no entorno e-learning. Nele se detalhará como se podem trabalhar ditas competências em cada uma das fases de tomada de decisões do simulador empresarial chamado "Fórmula i". O usuário deve gerir uma escuderia de Fórmula 1 tentando de obter os melhores resultados esportivos possíveis a partir de uma série de decisões tanto estratégicas quanto operativas. Finalmente, através de um modelo econométrico de regressão de elaboração própria, se analisam os resultados obtidos na sua primeira posta em prática para avaliar a influência desta metodologia na avaliação da gestão de competências dos recursos humanos na empresa.

PALAVRAS CHAVE *business games*, avaliação competências, resolução problemas, simulação empresarial.

Introduction

The introduction of new technologies into society has created the need for interactive contents that allow users to take advantage of their potential. Business simulators are framed within this context. They can be defined as interactive applications whose main purpose is not leisure but education in various fields, such as health, marketing and education.

Business simulators (Lacasa, 2011) make it possible to access knowledge in a meaningful way and contribute to the acquisition of both critical reflection tools (analysis, synthesis, generation of ideas and decision making) and interpersonal skills (cooperative work, leadership, individual responsibility, self-analysis and effective communication). Due to their characteristics and practicality, they are considered active methodologies, since they place users in a setting with circumstances that promote a cooperative learning process (Abt, 1987).

The potential of simulators as learning tools was recognized from the beginning (Malonne & Lepper, 1987). In fact, various institutional studies (Federation of American Scientists, 2006; Project Tomorrow, 2008) confirmed the idea that simulators and games in general can improve certain skills and competences acquired by users through education and these are later transferred to the business world.

This study is based on the idea that most workers have acquired specific abilities during their education, depending on the major chosen. However, currently businesses also demand transversal or generic skills suitable for professional performance (Arquero, 2000). This simulator is intended for professionals who are actively working in companies to achieve and improve some of those abilities.

Some of these skills are related to the individual's personal abilities, such as planning and organizational skills. In the case of economists, this professional skill is highly required by companies (Periáñez et al., 2009). In the end, workers' profiles should not be based solely on their duties but also on their competences, since professionals are required to have an open, multipurpose character with flexibility and ability to adapt to concrete situations, mainly in the financial and insuring sector (Bates & Atkins, 2003). Achieving these skills allows for the maximization of a company's effectiveness (Rajan et al., 1999).

This article analyzes a simulator used in the business field. First, the business simulator concept is defined, as well as its generic objectives and the specific competences that are intended to be achieved with a simulator. The following sections provide specific information on the simulator studied, such as use, functionality and application for training human resources in a company.

Business games or business simulators

A business game is a kind of serious game. It is used to acquire business management knowledge, competences and skills and to promote entrepreneurship. Business games are commonly used in universities, business schools, training centers and agencies that train future entrepreneurs. Their main objective is to provide the user with an overview of a company's operation and how its areas are interrelated. Users can also learn how competition influences business decisions and vice versa.

Many skills can be developed through business games. However, it must be taken into account that users provide their previous skills and knowledge to the community. Therefore, interaction and collaboration among each other is required in the learning process (Pivec & Pivec, 2011).

Concerning the simulator under study, two objectives are intended:

- Analyze its potential as a human resource learning and development tool.
- Analyze how the new learning methodology developed through the simulator fosters the acquisition of the competences and skills listed below.

For this purpose, the concept of professional competence is defined as the set of knowledge and skills that enables a person to exercise a professional activity according to production and employment requirements. In other words, this concept comprises a set of capabilities of a different nature that make it possible to obtain a result (Congress of Deputies, Spain, 2002).

The most important competences and skills developed through the game are:

- **Innovative spirit.** To move forward in the game, it is essential to take into account innovation as a distinctive and necessary element

that promotes competitiveness. This is particularly applicable to the development of new car part levels through a continuous improvement process where the fastest team will have specific advantages. There are other decisions where being innovative can make a difference. For example, when the strategy is using non-traditional tires or when long-term strategies involve immediate sacrifices for the sake of future benefits.

- **Problem-solving skills.** During the season, unexpected situations will come up and they must be solved in the best possible way. Budget or time restrictions when it comes to getting sponsors, doing merchandising or choosing between part repairing or pit stop training are some of the challenges that users or managers must face in order to choose the best options for the team.
- **Risk capacity.** In certain situations, decisions that involve risk taking allow the users to progress in the game. Taking those risks or not will depend on the managers' profile, their risk appetite and their proper assessment of the various scenarios that might emerge depending on the decision made. Traditionally, the worse the situation for the team, the more risks should be taken. However, taking risks at the beginning or in positive contexts could be decisive for winning the game. Anyway, it must be taken into account that taking risks implies possible negative results, therefore it could be more convenient to choose prudent strategies.
- **Continuous improvement.** The game implies progressing constantly until the highest category is achieved. However, such category is very difficult to maintain. Therefore, car part levels must evolve as quickly as possible, trying to match and even outperform competitors. Also, the driver has to be the best, which requires being aware of the transfer market situation, in case it is possible and convenient to hire a better one.
- **Quality orientation.** In order to advance in the game, achieving good quality indicators in terms of car design is essential. All manager-controllable variables must aim at excellence to the extent allowed by the budget.
- **Effort value.** Effort is required in order to progress in the game. It is not an immediate objective, since it can only be achieved after a while. Groups are composed of 24 teams and an equal number of managers. Among them, there will undoubtedly be great managers and people who will carry out various strategies. In such a scenario, victory will not come by chance. Because it is a context that implies risks, luck will obviously be present, but in the end it will favor those who made thorough management decisions and those who analyzed the greatest number of variables.
- **Analytical ability.** The ability to analyze all available information is fundamental to make good decisions. It is very important for managers to record thoroughly all race-related data, so that they can use that information in later analyses.
- **Planning and organizational ability.** It is the ability to effectively determine the purposes, goals, objectives and priorities of the task to perform. It implies organizing the activities, deadlines and resources required and controlling all previously determined processes. A long enough time horizon in the game requires an efficient and timely planning capacity.
- **Strategic ability.** On many occasions, the user will have to renounce reaching a landmark and save resources, with the purpose of obtaining future benefits.
- **Autonomous learning.** It is the users' ability to learn more independently each time, developing initiative and responsibility based on their own learning. The simulator's manual is only the first step. Managers themselves must make sense of the information and determine which dynamics can help them to obtain the best results.
- **Creativity.** Ability to find new and different solutions to conventional problems and situations. The platform determines the rules of the game and the environment's operational system, but there are very different ways to use it. Thinking differently can bring good results.
- **Accuracy.** Ability to be precise and make careful decisions. Proper car settings can generate a millisecond difference that will make it possible to obtain a better starting position,

which can in turn imply winning the race. On many occasions, apparently insignificant details will make the difference.

The simulator studied shows the steps to create, start and manage a Formula 1 team. Professionals from six companies have used this simulator. The methodology was developed within the competence development program of human resource areas in six companies. It was aimed at middle-management levels.

On the platform, the user becomes a team manager who will try to obtain the best results by making both strategic and operational decisions. Managers will usually compete against 23 teams in a 17-race season. They start off in equal conditions before the first race. The main objective is for the manager to carry out proper management, bearing in mind the sporting and financial situation at all times and taking risks as appropriate. We will now analyze the Formula i business game.

Formula i

Several researchers (Reese, 2007; Kearney & Pivec, 2007) believe that business simulators contribute to the users' learning process and immerse them in the virtual world or space where the simulation takes place.

This business game is designed for progressive learning, so simple but important operations will be required at first. They will make users familiar with the application and the activities required (Figure 1).

As users progress within the simulation, they must make important decisions that follow a certain order. These decisions are related to choosing the right pilot, their training, scores, risks to be taken and the strategy to use during the race. Regarding pilot selection and proper feature evaluation, the user must take into account the following aspects:

- The market is common and new pilots emerge after each race. If too much time is spent deciding whether to hire a pilot or not, another team can do it first.
- Features are valued between 0 and 100. The higher, the better.
- The "experience" variable increases over time.
- The "motivation" variable fluctuates, depending on the results obtained.

While training, managers can test different part configurations to then decide which one should be used in the qualifying laps, which is really decisive. In this sense, it is advisable to train:

- With the softest tires, because they are faster. It is recommended to choose between the four dry-weather tires. Two of them can be tested in each circuit. As a general rule, the fastest tire will be used in the qualifying run. However, if part set up implies extra training laps, it could be interesting to check time differences if the other tires are used.
- With the lowest fuel level, as recommended in the qualification lap.
- With minimal risk, so that it affects time as little as possible.

Qualifying determines each car's starting grid position. It is divided into Q1, Q2 and Q3. Each Q implies two laps. Since classifications change as pilots run each lap, the longer running times, the more information will be available. There is a time limit too. It is advisable to qualify:

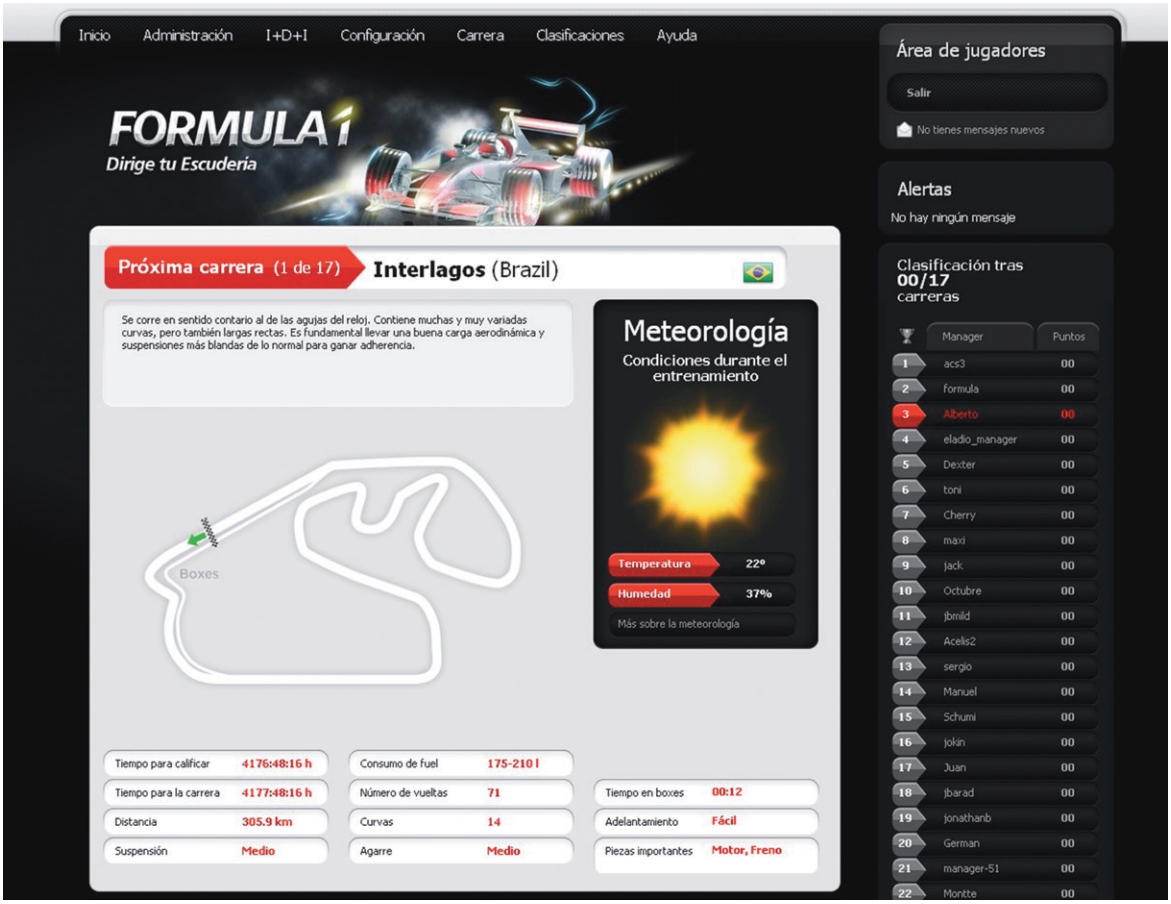
- With the optimal configuration of parts used for training.
- With the lowest fuel level.
- With the softest tires between the two options available. Another strategy could be using the hardest tires at the start in order to stretch the first pit stop and run the final laps before that with less traffic.

In regards to risk, taking certain risks during qualification may be advisable, especially if qualification is based on other pilots' results. Qualifying laps also have a cost, so if good results are obtained in the first Q round, it may be a good idea to give up the second lap.

Concerning race strategy, the most appropriate part configuration should be used after analyzing warm up and training laps. In terms of fuel load, part development level and pilot features can contribute to lower consumption, since a perfect pilot and car could run with the lowest load specified for the circuit. In any case, in order to avoid surprises, it is advisable to run with the maximum load. In terms of risk, sub-risks could be modified between each lap during the race, besides the following aspects:

- Race risk is taken in general, in every lap. Running with no or only a few risks would be

FIGURE 1. Opening screen of the Formula i business game.



Source: www.formulai.net

advisable, but with a good pilot certain risks could be taken when race circumstances require so.

- Start risk is taken at the beginning of the race. If the results are good, better positions can be obtained. However, bad results will imply leaving the race. It is a mixed blessing that must be used taking into account pilot features, starting position and race expectations.
- Blocking risk is assumed when another driver tries to overtake. Risk taking will help the driver hold a position, but it can lead to accidents.
- Overtaking risk is taken when attempting to pass another driver. The implications are the same. If overtaking is not a good maneuver because the other driver is better, because own times are not so different from those of the other team or because the circuit does not allow so, certain risks could be assumed, but it is important to take into account that doing so could cause accidents.
- Risk in case of a technical problem replaces race risk if a car part is damaged. If the overall strategy is conservative and the purpose is to end the race, this risk would have to be reduced to the maximum in order not to force the damaged parts.

Decisions related to investigations, the mechanical workshop or marketing, which can be made before the race

Concerning investigation, one of the basic aspects to obtain good sporting results will be the car. If its parts are well developed, it will have good results in terms of times. Its five parts (engine, gearbox, flaps, brakes and suspension) can be

developed from levels 1 to 10. First-level development will take less time than higher-level development. For example, upgrading a piece from level 9 to 10 could require half a season. It will always be advisable to investigate, especially when racing across several seasons. It must be taken into account that as seasons pass, all parts go back one level (up to the minimum = 1), so it is interesting to begin investigating as soon as possible. Concerning long-term ambitions, the ideal scenario is to advance at least two levels per season.

The first step to investigate parts is hiring engineers. Engineers cannot conduct several investigations simultaneously. Hiring engineers is similar to hiring pilots, but in this case the following variables must be kept in mind:

- **Speed.** Fast engineers could have new developments ready several races before slow engineers. However, this feature will be more useful in the long term and with higher developments. At low levels, this variable would not be noticed that much.
- **Efficiency.** After developing a new level, the new design must be tested for reliability. In this regard, it will be better to have effective engineers. If a design fails reliability tests, it would have to be tested in another race to see if it works properly on that occasion.
- **Each part's potential.** It defines the levels that the engineer is able to develop for each piece. At first, it will not be necessary to have engineers with a high potential because simple pieces are developed. In that case, the manager would be paying money unnecessarily to engineers with a potential that is not going to be exploited.

The second step, as long as it is financially possible, is to invest in technological elements such as a fluid dynamics simulator, since it streamlines investigations, and a wind tunnel, which increases design reliability.

The third and final step would be choosing which parts require analysis and which engineer will be in charge of that investigation. The timetable at the bottom of the screen will show when the new level will be ready, as long as there are no reliability problems. If that investigation is successful, a car part of that new level could be bought at the mechanical workshop. In case the investigation fails, time is automatically extended.

In terms of what parts are worth investigating, it is advisable to increase levels in a balanced way. However, priority must be given to the engine. It could also be interesting to examine which circuits are going to be run with the new development and see which parts are important then.

Concerning the mechanical workshop (Figure 2), it is used to purchase new pieces and fix the ones that need to be repaired. If the user has just successfully completed an investigation, buying a new part of that level before training would be convenient. This screen would also be seen if a piece is unusable after a race. Except these two cases, the moment when mechanical workshop decisions are made is irrelevant. New part purchase is recommended when the ones being used wear away, in order to be ready for the next race. On the other hand, up to eight engines and five gearboxes can be used throughout the season, so they can be used alternatively when appropriate.

Concerning marketing policies, the manager has 100 hours before every race to work on merchandising or negotiate with sponsors (Figure 3).

Merchandising work improves revenue before a race. The amount received is closely related to:

- Number of hours devoted.
- Race results.
- Season classification position after the race.
- The pilot's level.
- The car's level.

In any case, devoting resources to merchandising should be an option only when deals with sponsors have already been signed or when it is clear that due to the team's level it is possible to obtain good results by investing time on this issue.

The key aspect would be to negotiate with sponsors. From the start, there are three sponsors that were obtained last season, which guarantee a fixed income after each race. But before the next season, it is important to close the best deals. In order to do so, for each type of sponsor (main, pilot, etc.), there is one which is very interested in sponsoring the team, so there is no need to negotiate with it. However, it would be possible to obtain more advantageous deals.

If long time is spent negotiating with a sponsor, the progress obtained will be seen after the race. It will depend on hours spent, race results, season classification position after the race, the pilot's level and the car's level. However, it should be noted that while the main sponsor will pay attention to all the variables, the pilot's sponsor

will pay special attention to the pilot's level. At the same time, a sponsor labeled as "other sponsors" will pay special attention to the car's level.

In line with this, the recommended strategy depends once again on the team manager's risk appetite. However, it would be reasonable to focus on negotiating with an accessible sponsor, analyze the progress made and choose a better sponsor from another category if there are enough races to close another deal. The best sponsors will only be available for the most complete teams, so it is recommended not to waste time trying to close a deal when it might have been possible to close two deals with lower amounts. It is also recommended to devote time to several negotiations, to see which one is more likely to be closed based on the results, since they change over time.

Statistical analysis

This simulator is very recent. It was used in 2012 by 144 workers in six companies. In order to evaluate the competences acquired, a previous test was performed before simulator use. Then, after using the simulator for six weeks, another test was carried out.

In order to develop the methodology, the simulator, its training manual and a common test were used. This test was administered by human resource managers of the six companies. The purpose of the test was to assess the results obtained through the use of the simulator.

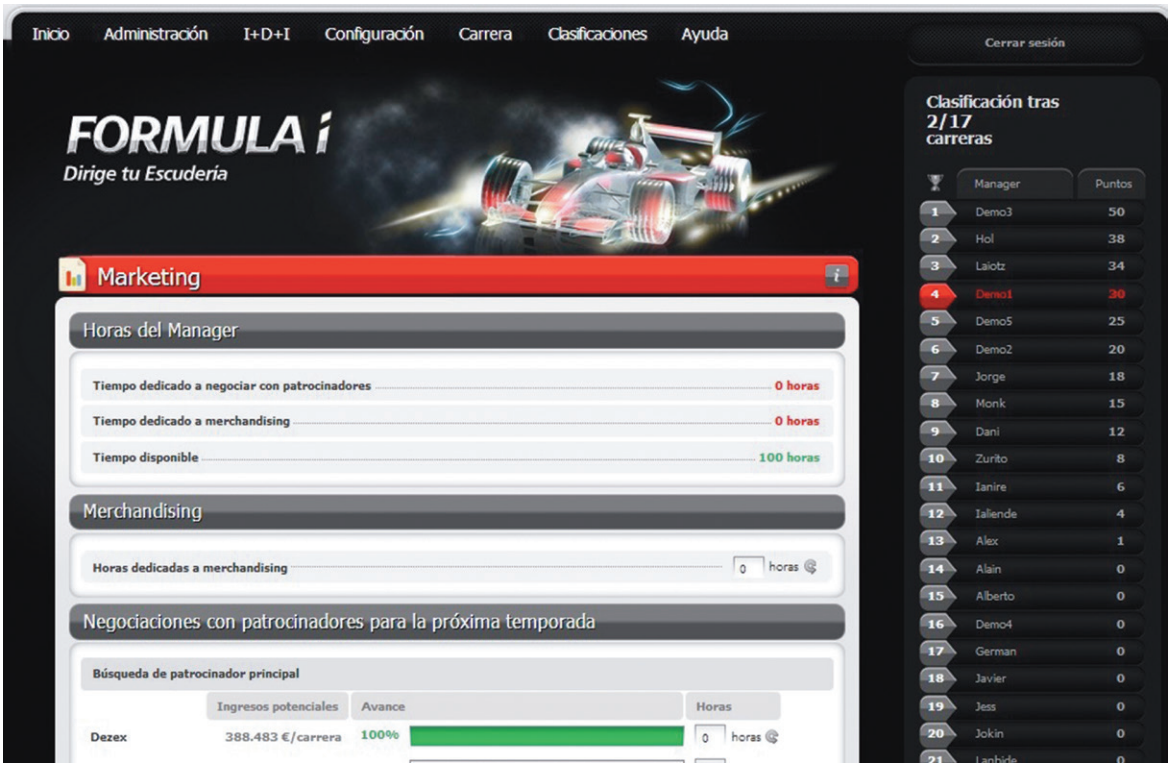
The number of hours devoted to the simulator were analyzed, since it is an important variable. During the evaluation process, behavior, actions and decision making in certain situations were analyzed to see how each user's skills and abilities improved, taking into account that the situations or scenarios chosen for both assessments were more or less similar, in order to avoid bias when analyzing the results of both tests.

Users were asked if they see this tool as a didactic methodology to learn how a company (in this case a Formula i team) is managed. Also, they were asked if they thought they could develop

FIGURE 2. Mechanical workshop screen

Source: www.formulai.net

FIGURE 3. Marketing decisions



Source: www.formulai.net

multiple competences with the simulator. The results show that 80% of users believe that it is very good or good, compared to 20% who think that it is average or not very useful.

In regards to managers of participating companies, 90% believe that this simulator adds value to workers, since it allows them to learn in a practical way how a large company is managed when there are various variables to pay attention to and problems to be solved. In this way, users can know the activities carried out by other areas of the company and the alternatives available to solve various problems.

Business simulator development required some algorithms. They are the mathematical foundation that allows us to relate the results obtained from the endogenous variables that were calculated through the data of the exogenous variables included in the entire model. The model used for evaluating the results obtained is the ordinary least squares, which is used to estimate an unknown variable in a linear regression and minimizes the sum of squares of vertical distances between the responses in the data set and the responses predicted by linear approximation. The resulting estimator can be expressed through a simple formula, especially in the case of single regressors (Greene, 2002).

As mentioned above, this study includes data of 144 workers in six companies (24 people in each of them). They participated in a skill and competence enhancement activity called Formula i, a business simulator. During the evaluation, it was kept in mind that in order to play it was not necessary to know anything about the Formula 1 world. The simulator has a sports manager who provides technical information on trainings, classifications and races. After the evaluation, data from a set of variables was collected. They are mentioned below.

Variables considered by this study

- Obj_i: variable that measures if the "i-th" worker reached the minimum objectives set by the simulator (0 or 1 values).

- $Genero_i$: gender of the "i-th" worker (1 for a man, 0 for a woman).
- $Valor_i$: score obtained by the "i-th" worker in the simulator activity (from 1 to 10).
- $Evcompant_i$: score obtained by the "i-th" worker in the competence assessment before the simulation activity (from 0 to 100).
- $Evcompactual_i$: score obtained by the "i-th" worker in the competence assessment after the simulation activity (from 0 to 100).
- $Estud_i$: educational level of the "i-th" worker (3: upper level; 2: medium; 1: basic). It has been treated as a quantitative variable.
- $Horas_i$: the number of hours spent by the "i-th" worker in the simulation activity.
- $Edad_i$: "i-th" worker's age.

A linear regression model was specified and its dependent variable was the aspect under analysis: competence assessment after the activity. It is an ordinary least squares (OLS) model used for estimating mean competences achieved after the simulation activity.

The explanatory variables are Obj_i (if the user has been able to reach some minimum goals in the business simulator), $Valor_i$ (the score obtained in the simulator activity), $Evcompant_i$ (competence assessment before the activity), $Genero_i$ (gender), $Estud_i$ (educational level), $Horas_i$ (number of hours spent on the activity) and $Edad_i$ (age).

$$Evcompactual_i = ß_1 + ß_2\, Obj_i + ß_3\, Valor_i + ß_4\, Evcompant_i + ß_5\, Genero_i + ß_6\, Estud_i + ß_7\, Horas_i + ß_8\, Edad_i + u_i$$

When this linear regression model was analyzed, it was observed that the gender and age variables were not significant enough to explain competence assessment after simulator use. Therefore, they were omitted from the regression model.

Final econometric regression model

$$Evcompactual_i = a_1 + a_2\, Obj_i + a_3\, Valor_i + a_4\, Evcompant_i + a_5\, Estud_i + a_6\, Horas_i + v_i$$

After eliminating the gender and age variables because they were not very significant, an estimation model was obtained. In this model, all the variables are individually relevant, with t-statistic values greater than 2, and they are also relevant altogether (F-statistic (5, 138) = 215,18 ($p < 0{,}00001$)).

As it can be seen in the estimated coefficients, the model shows that all explanatory variables influence positively current competence assessment. This result is consistent with our expectations, given the relationship between each explanatory variable and competence assessment.

Almost 89% of variance in the dependent variable (table 2) is adjusted, which is a good number. It leads to the conclusion that this regression model is acceptable to describe how the simulation activity has strengthened workers' competences. It also allows to predict future results after working on this business simulator.

For six weeks, due to the time spent on the game and the experience and results obtained, players followed an autonomous learning process that affects decision making. The sample of workers who used the simulator was analyzed through a linear regression model in order to know what variables enhanced the competences that were intended to be developed. Those variables are competence assessment before the activity, the score obtained by working with the simulator, the worker's educational level and the number of hours spent on the activity.

TABLE 1. OLS values using the 144 observations 1-144

VARIABLE	COEFFICIENT	ST. DEV.	T STATISTIC	P VALUE	SIGNIFICANCE
const	7,46836	3,433	2,1755	0,0313	**
Obj	3,89471	1,45789	2,6715	0,00846	***
Valor	3,05912	0,393959	7,7651	<0,00001	***
Evcompant	0,545483	0,0609398	8,9512	<0,00001	***
Estud	3,03382	0,740905	4,0947	0,00007	***
Horas	0,559275	0,158678	3,5246	0,00058	***

Note: Dependent variable: Evcompactual.

Source: Own elaboration.

TABLE 2. Results of the main statistical values

Median of the dependent var.	73,7758
Standard deviation of the dependent var.	13,1204
Residual sum of squares	2798,5
Standard deviation of the residuals	4,50322
R_2	0,886317
Adjusted R_2	0,882198
F-statistic (5, 138)	215,18
Log-likelihood	-417,953
Akaike information criterion	847,906
Bayesian or Schwarz information criterion	865,725
Hannan-Quinn criterion	855,146

Source: Own elaboration.

Based on this, it can be concluded from the results obtained in the simulation activity that all the skills that we sought to promote were improved, especially planning and organizational ability, strategic capacity, autonomous learning and creativity. Therefore, the authors believe that by fostering the competences proposed both objectives were achieved: analyze the potential of the simulator as a human resource learning and development tool and, therefore, verify the potential of this didactic methodology through simulator use as a tool to acquire and enhance professional skills.

Comparison with other simulators

This simulator, called Formula i, has been improved in comparison with other Formula 1 serious games where users can play as team managers, since it has the possibility of creating private teams. It is a private project and its algorithms were developed with the collaboration of the Formula 1 expert Sergi Sanchez, a telemetry advisor for GP2 and Lotus teams. Its differentiating element is that it takes gender equality into account, since it gives the user the option to hire either men or women as engineers or pilots. There are four references worldwide for public teams (massive internet competitions open to the general public), but none awards prices. However, this simulator does include prices, which is as a very important differentiating element. For private competitions, from the didactic point of view it is without a doubt an innovative methodology to work on managerial competences and abilities and the integral innovation cycle.

This simulator is accessible from any desktop or mobile device (Android or IOS). In order to support tens of thousands of users, it is hosted in the cloud (cloud computing). The system consists of four eight-core servers each. One of them balances data loading from the other three servers. There are mainly three differentiating aspects between this simulator and other Formula 1 manager games:

- **Gender equality**. It is possible to hire men and women as pilots or engineers. This is not possible in other racing simulators.
- **Multi-platform concept.** Existing Formula 1 simulators have not been developed as a multi-platform environment. Most of them cannot be accessed from all devices.
- **Real time decision-making.** Possibility of making tactical decisions during a real-time race, managing risks under pressure and with specific objectives.

Simulators that have been compared to Formula i are:

- www.escuderiasgp.com
- www.topracers.net
- www.f1portal.net
- www.boxf1.com
- www.f1champonline.com

Advantages and disadvantages of simulator use

After analyzing the implementation of the Formula i business simulator, it has been confirmed that a potential improvement of serious games and mainly business games would be having a feedback system that rated and monitored the decisions made by the users, so that the reason of their choice could be explained. With his feedback, if the decision was not very accurate, the user could redirect that choice and choose a better option. The advantage of such feedback would be further learning enrichment. On the other hand, one of the drawbacks would be a high job and economic investment for the companies that use it.

These games have many more benefits than drawbacks, because they complement the skills obtained by workers through traditional activities. Therefore, these games add value to previous training. At the same time, business games show the relationship between different areas of a company, in this case, an F1 team. Therefore, they provide insight on how a company is managed and how the different areas of a team are interrelated and internally coordinated. Also, these games foster strategic decision-making. They show entrepreneurs the steps to follow and the decisions to make when starting up a new company. They also encourage team work, since decisions in a specific area require coordination with others.

The simulator is completely online, which eliminates problems arising from the participants' location and the difficulty of meeting physically. On the other hand, it is an effective system to reinforce the participants' knowledge on enterprise management and marketing. It also allows them to develop problem-solving abilities through joint decisions between team members. In this order of ideas, with this simulator the user can learn from wrong decisions, can learn to manage time effectively and can learn to manage the financial and human resources of a company.

The use of this business simulator adds value to users, since it allows them to learn in a practical way how a large enterprise is managed with a multitude of variables and problems to solve. Besides getting users familiar about the activities carried out in other company departments, it helps them to identify the problems faced by those other areas, which can be even more important than those of the area where the user works. Therefore, this kind of games teach players about relativity and helps them to consider the importance of an area's problems.

In terms of disadvantages, only two are worth noting. On the one hand, the non-simulation of daily tasks and, on the other, the large investment it implies if use needs are not properly managed. Business games develop managerial skills and decision making in different administration and technical areas, but it does not simulate daily tasks carried out within a company or, in this case, within a team, such as accounting, relationships with suppliers, trip management, among others. To do this, the "simulated company" application can be used. It is not a serious game, but it implies the preparation of some premises within a training center where a fictitious company develops its activities in a simulated environment.

Final considerations

As described in the previous section, the use of the Formula i simulator has some disadvantages, but its implementation also implies various advantages, since business games develop managerial and decision making skills in different areas. They are the perfect tool to expand and improve managerial capabilities and skills and to teach contents and values in an attractive and efficient way.

From the results on business simulator use it can be concluded that it adds value to users, because it allows them to learn in a practical way how a large company with several variables and problems can be managed. In addition, it familiarizes users with the activities carried out by other company areas and helps them to identify problems faced by those other areas, which are just as important as the area where the user works. Therefore, it teaches users to prioritize the importance of an area's problems by showing in detail the functions of other company areas.

The sample of users who worked on the simulator has been analyzed through a linear regression model in order to know which variables strengthen competences and predict future behaviors. In consequence, it can be concluded that the variables that influence the results obtained through simulator use (competence assessment after conducting the activity) are competence assessment before the activity, the scores obtained after working with the simulator, the worker's educational level and the number of hours spent on the activity.

Based on this, it can be concluded that the simulation activity improved the users' competence assessment. In addition, by strengthening the competences proposed two additional objectives were achieved: analyze the potential of the simulator as a human resource training and development tool, therefore, confirming the potential of this learning methodology as an instrument for obtaining and strengthening professional competences.

REFERENCES

Arquero, J. L. (2000). Capacidades no técnicas en el perfil profesional en contabilidad: Las opiniones de docentes y profesionales. *Revista Española de Financiación y Contabilidad*, *29*(103), 149-172.

Bates, I. & Atkins, D. (2003). *Management of Insurance Operations*. London: Global Professional Publishing.

Federation of American Scientists. (2006). Harnessing the Power of Video Games for Learning. En *Proceedings of the Summit on Educational Games*. Washington. Retrieved from: http://www.fas.org/gamesummit/Resources/Summit%20on%20Educational%20Games.pdf

Greene, W. H. (2002). *Econometric analysis* (5th ed.). New Jersey: Prentice Hall.

Lacasa, P. (2011). *Los videojuegos: aprender en mundos reales y virtuales*. Madrid: Morata.

Malone, T. W. & Lepper, M. R. (1987). Making learning fun: a taxonomy of intrinsic motivations for learning. En R. E. Snow & M. J. Farr (Eds.), *Aptitude, Process Analyses* (vol. 3). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Project Tomorrow. (2008). *Speak Up 2007 for students: teachers, parents & school leaders*. Irvine: Project Tomorrow. Retrieved from: http://www.tomorrow. org/docs/national findings speak up 2007. pdf

Periáñez, I., Gómez, P. M., Luengo, M. J., Pando, J., de la Peña, J. I. & Villalba, F. J. (2009). *Estudio para la detección de las competencias profesionales de un economista desde la perspectiva del empleador*. Madrid: Consejo General de Colegios de Economistas de España.

Rajan, A., Van Eupen, P. & Chapple, K. (1999). *Skills in financial services: insurance, banking & building societies*. Kent: Centre For Research In Employment & Technology In Europe.

Pivec, P. & Pivec, M. (2011). Digital Games: changing education, one raid at a time. *International Journal of Game-Based Learning*, *1*(1), 1-18.

Reese, D. D. (2007). First steps and beyond: *serious games* as preparation for future learning. *Journal of Educational Multimedia and Hypermedia*, *16*(3), 283-300.