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ASSESSING INDIVIDUAL PERFORMANCE IN A TOTAL ENTERPRISE SIMULATION

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ABSTRACT

Although empirical studies have demonstrated there is no positive correlation between simulation performance and learning, in almost all business simulation exercises such indicator is used to evaluate participants. Considering that in real-world individual are usually evaluated by performance, and rarely by learning, it is justifiable to continue using simulation performance as an assessment indicator. Therefore, this paper extends existing literature presenting a methodology to assess individual performance in a total enterprise simulation course. Findings of first applications using such methodology are reported. Advantages of the devised methodology are also discussed.

KEYWORDS: business simulation; assessment, individual performance.

INTRODUCTION

Assessment in business simulation courses is somehow controversial. At one hand, empirical evidence shows that the great majority of instructors using total enterprise simulations grade their participants based on simulation performance (Anderson and Lawtson, 1992b). On the other hand, authors argumentations (Anderson and Lawton, 1997; Teach, 1990; Thorngate and Carroll, 1987) and empirical evidences (Anderson and Lawton, 1992a; Wasbush and Gosen, 2001) have demonstrated that there is no relationship between simulation performance and learning. This paradox can be explained by Washbush and Gosen's (2001: 292):

> *… in real-world organizations, managers and employees are continually evaluated on performance and rarely on learning. In the university, we usually grade on mastery or performance via test or paper after the completion of a unit rather a change from one level of understanding, knowledge, or analytical ability to another. Grading on performance is what we usually do…*

Considering simulation performance will continue to be used in total enterprise simulations, a question arises: What are the most appropriated performance indicators? Profits, and other financial and economic indicators, are commonly used to evaluate simulation performance. However, as in real-world (Dearden, 1969; Eccles, 1991; Fisher, 1992; Kaplan, 1983; Ridgway, 1956), performance based only on such indicators has also been criticized in business simulations (Teach, 1990; Teach, 1997).

In real-world many integrated and balanced measurements systems have emerged (Atkinson et al., 1997; Eccles and Pyburn; 1992; Kaplan, and Norton, 1992; Vitale et al., 1994). In simulated world some integrated performance systems have also been devised (Frizsche and Cotter, 1997; Thorelli, 1997). However, simulated performance systems continue to be used to evaluate simulated company as a whole, not individual performance.

One exception is Teach's (1997) work that has assigned individual indicators to each managerial function in a given business simulation. Four functions were considered in Teach's model: manufacturing, marketing, comptroller, and executive. Comparisons are made using two indicators by function. Values from these two indicators are plotted on a graph along with the data for the other firms and distributed to all the firm's specific functions. In doing so, each function can be evaluated against the industry standard or based upon their ranking with their counterparts in the other firms.

Present paper also focuses on individual performance. However, it differs from Teach's work in three aspects. First, Teach devised a performance measurement to be used in a specific business simulation. The methodology presented in this paper aims to be as generic as possible. Second, the business simulation used by Teach was developed to have no face-to-face contacts among team members during the decision making process. By contrast, this paper has specific dynamics to be applied in face-to-face meetings. Finally, in Teach's work there is no emphasis on grading scores, as present paper does.

This paper addresses individual performance to enrich literature in two aspects. First, in real-world integrated company performance systems are closely related to individual performance evaluations (Eccles and Pyburn; 1992; Ittner and Larcker, 1998; Otley, 1999). However, this is not the case of business simulation environment (Frizsche and Cotter, 1997; Thorelli, 1997). Second, using business simulations in regular basis since early nineties, this author has observed that, although teams are formed by individual functions, performances are usually evaluated by company performance. Consequently, individual efforts spent to achieve this performance are not considered. For example, a student has no effectively participated of the decision making process will receive the same score of the remaining team members. Therefore, introducing a grade based on individual performance can solve this problem. Additionally, it can also bring more realism to the business simulations because, as in real-world, trade-offs between functions is expected to be more accentuated during the decision making process.

METHODOLOGY TO ASSESS INDIVIDUAL PERFORMANCE

The methodology to evaluate individual performance in business simulation courses assumes that two basic conditions exit. First, the decision making process is performed in teams, not individually. Second, business simulation is expected to provide indicators of performance to each function. At this regard, this methodology is more appropriated to be used in total enterprise simulations, also called top management games. Keys and Biggs (1990:49) define such simulations as:

> *A total enterprise game is one which includes decisions in most of the main functions of business: marketing, production, finance, and personnel. Such games require integration of the various functional areas. In addition, total enterprise games incorporate environmental factors, such as general economic conditions and interest rates as important components of the learning experience.*

Once a team approach is preferred, and a total enterprise simulation is available, the methodology can be applied. Initially each participant is assigned to one team and to one managerial function such as finance, marketing, production, or personnel. Usually, these assignments can be random, self-defined, constrained self-selected, or defined by the instructor (Bacon et al., 2001). However, the methodology will privilege a self-selected assignment to managerial functions followed by a random assignment to team. When participants select their functions, confidence in the decision making process is expected to be higher. On the other hand, random assigning to teams is expected to create more heterogeneous groups. Associated with individual evaluations, this heterogeneity will proportionate a more real-world proximity because conflicts are expected to emerge more frequently in the decision making process.

A one-to-one assignment of participant to function is preferred. Number of available team members superior or inferior to functions is not advised because it can influence individual assessments. The number of enterprises to be simulated is a logical strategy to solve this problem. A complementary strategy is creating the Chief Executive Officer – CEO function. Participants in this position will be responsible for coordinating the decision making process, and intermediating eventual conflicts between team members.

Next step is defining performance indicators to each function. Considering practical aspects, all indicators should be extracted from reports issued by the business simulator. The number of indicators to each function will depend on the simulation complexity. However, three or four indicators are more advised. One or two indicators will make the assessment very sensitive. More than four indicators can turn the assessment very complicated to be managed with marginal gains. Table 1 shows a list of suggested indicators to each managerial function. Such indicators can be extracted from the majority of total enterprise simulations. As it can be seen, the CEO position, when existent, will continue to be assessed by company performance indicators.

TABLE 1 – Performance indicators associated to functions

Function	Performance Indicator	Assessment
Marketing	Market share (%)	HB
	Sales growth (%)	HB
	Sales ($)	HB
	Demand to sales ratio (%)	NZB
Production	Unit product cost ($)	LB
	Productivity (number)	HB
	Production programming	NZB
	Employee motivation (scaling)	HB
Finance	Cash flow balance ($)	LB
	Abnormal interest paid ($)	LB
	Current liquidity ratio (%)	HB
	Debt to asset ratio (%)	LB
Personnel	Employee turnover (%)	LB
	Employee productivity (number)	HB
	Motivation (scaling)	HB
	Employee balance (necessary / existent)	NZB
CEO	Share value ($)	HB
	Return on equity (%)	HB
	Net profit margin (%)	HB
	Cumulative dividends ($)	HB

NOTE: HB = Higher Better; LB = Lower Better;
NZB = Near Zero Better (negative and positive values are possible)

Before scoring individual performance, weights have to be attributed to each indicator. Two strategies are indicated. A simpler strategy is weighting equally all indicators within a function. Another strategy is differentiating weights among indicators. The total sum of weights, however, must be 1.0, i.e. 100%, to each function. The weights can be altered by the instructor, tailoring them to meet specific needs, as also suggested by Frizsche and Cotter's (1997) assessment tool.

Once assigned participants to functions, defined indicators and attributed weights to each indicator, the next step is scoring individual performance. At least 3 options are possible. First option is scoring each indicator using a scaling raging from 1.0 to 10.0. Best performance in a given indicator receives score 10.0, while worst performance receive score 1.0. Remaining performances are assigned proportionate scores. For example, in a simulation with 3 companies attributed scores are 10.0 (best), 5.5, and 1.0 (worst).

Second option is based on a discrete scaling, ranging from 1 to number of simulated companies (X). Worst performance is attributed score 1, while best performance receive the score related to X. Other performances are scored between 2 and X-1. In the two previous scales a constant gap exists between scores. Therefore, participants can estimate how many positions they can gain or losing in the next scoring, independently of the gaps among performances. However, as the gap between the best and the worst scores remains constant, distortions can arise; that is, lower performances will attributed the same score, no matter how distant they are from the top one.

Third option avoids such distortions, assigning to top performance a score of 1.00, and remaining performances scores which represent the proportion to the top. This option is similar to Frizsche and Cotter's (1997) suggestion to weight performance indicators. However, independently of the chosen option to score individual performance, individual score will be composed by the sum of scores achieved in each indicator. Table 2 presents a scoring example to the market share indicator in a simulation with 5 companies, considering the three cited strategies to assign scores.

TABLE 2 – Scoring a specific indicator

Company	1	2	3	4	5
Market share (%)	11	24	26	22	17
Ranking	5th	2nd	1st	3rd	4th
Scoring – option A	1.00	7.75	10	5.50	3.25
Scoring – option B	1	**4**	5	3	2
Scoring – option C	0.42	0.92	1.00	0.85	0.65

NOTE: Option A = scaling 1 to 10; Option B = scaling 1 to X; Option C = ratio scale

If an individual is absent in a given decision making process (considering the process is performed in classroom), it is possible to assign zero score to all indicators in this round to the absent individual. If this strategy is adopted, participants are expected to be more present in classrooms, because, otherwise, they will receive zero grades in each absent round. CEO, if existent, is advised to assume the function of the absent student, because a weak performance in a given function can prejudice company performance.

Once indicators are scored, they are disclosed by round (e.g., by quarter) and cumulative, because integrating performance assessment using more than one indicator and over a series of quarters reduce the luck factor and the good-day, bad-day syndrome (Frizsche and Cotter, 1997). Tables 3 and 4 present examples of scoring by quarter and cumulative, respectively.

TABLE 3 – Scoring an individual function by quarter

Function	Indicator	Performance	Ranking	Score
Marketing	Market share (%)	22	2nd	**4**
	Sales growth (%)	1	4th	2
	Sales ($)	2.987.451	3rd	3
	Demand to sales ratio (%)	13	1st	5
Total Score	Company 2			**14**

NOTE: Scores in quarter 2, considering 5 companies and option B scoring.

TABLE 4 – Scoring individual performance

Company	Marketing Director	Quarter 1 (score)	Quarter 2 (score)	Accumulated Score	Ranking
1	Member A	9	7	16	5th
2	Member B	13	**14**	27	3rd
3	Member C	13	16	29	2nd
4	Member D	15	15	30	1st
5	Member E	10	8	18	4tho

NOTE: Scores from quarter cells are extracted from Table 3, in row 'Total Score'.

Reassignment, the last methodology step, can be necessary for many reasons. For example, random assignments to teams can create a "bad" group (Bacon *et al.*, 2001); or, considering educational purposes, it can be important to a participant perform more than one managerial function. Therefore, methodology has to be flexible to cope with these eventual adjustments. Because participants have individual scores, these adjustments can be easily managed. The only concern is that scores received by the participant in previous rounds must be always associated to him, no matter in which each new team, or function, he will be assigned.

The methodology was devised to be as generic as possible. Eventually, some minor adjustments have to be done in performance indicators or scoring procedures. The methodology can be implemented using spreadsheets, or integrated to the simulation software. Latter option is preferable in terms of time savings. A step-to-step guide to the methodology is presented in Table 5.

TABLE 5 – Methodology to assess individual performance in business simulation courses

Step	Activity
1	Assign participants to functions and teams
2	Define individual indicators of performance to each function
3	Weight indicators
4	Score individual performance
5	Show results of individual performance
6	Adjust team or function assignments

PILOT PROJECT USING THE METHODOLOGY

This methodology was tested in a pilot project involving 63 undergraduate students enrolled in required business simulation courses at Universidade Federal de Santa Catarina – Brazil, during the first semester of 2003. Students were originated from 3 groups. In one group a manufacturing simulation – SIND (2003) was used; while the two other groups used a retailing simulation – SIMCO (2003). Both simulations are top management games with more than 30 decision inputs per round. They are considered complex simulations according to the Keys and Wolfe's (1990) definition.

Team members were formed using self-selected assignment to functions and random assignment to teams. No adjustments were done during the courses in terms of changes in team or function assignments. Each team was composed by four members performing the following functions: CEO, marketing, finance, and personnel (in retailing simulations) or production/personnel (in manufacturing simulation). Business simulation courses were graded using managerial (50%) and academic performances (50%).

Managerial performance is related to simulated business performance. Indicators to this performance were based on company performance (12.5% to share value and 12.5% to ROE); and individual performance (25% to indicators related to managerial functions). Grade system was adjusted to consider that all participants receive managerial performance grades sufficient to be succeed in the course; that is, the worst performances in share value, ROE, and functions will be always attributed the grade required to be approved in the course. In doing so, it will be assured that weak business performance will not be responsible to the student's fails in the course. This strategy is consistent with the rationale that simulated business performance is not related to learning. Therefore, if a student failure occurs, it will be associated with academic performance. The indicators used to evaluate academic performance were oral debriefing (10%), written debriefing (15%), and participation in decision making sessions (25%).

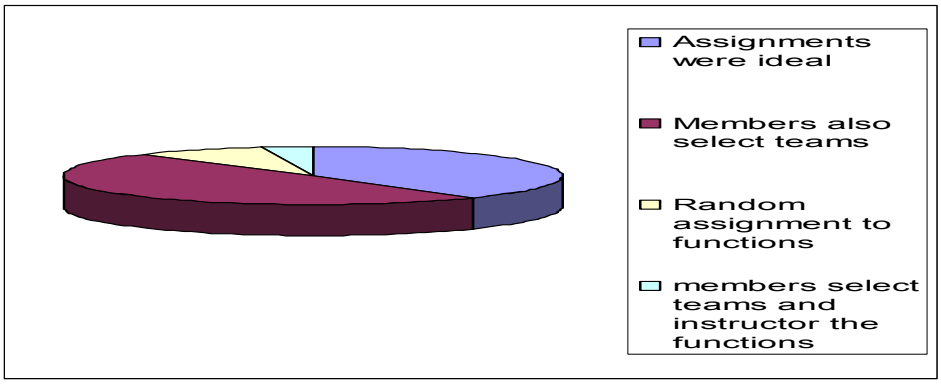
Courses were conducted during 9 simulated quarters, preceded by a practice round. Initial four quarters were simulated using traditional simulation performance evaluation; that is, return on equity and share value (an aggregated indicator composed by financial, economic, and market parameters). Individual performance was used in last five quarters. Indicators shown in Table 1 were used to assess individual performance. All indicators were equally weighted. Scores were attributed using option B strategy (worst performance = 1; best

performance = number of companies). Absent students in a given round were assigned the lowest scores in all indicators, independently of achieved performance in the quarter.

Preliminary administrations of individual performance assessment in business simulation courses have shown stimulating results. A blind questionnaire was administrated after business simulation courses have finished to gathering participant's perceptions about the grade system. Ninety-four percent of participants have answered to the questionnaire. In terms of member assignment to function and to team, 39 % considered the option chosen as ideal, 49 % preferred also selecting the team, 9 % preferred also random assignment to functions, and 3 % preferred to select the team and the instructor assign the functions. Figure 1 shows a graphic representation of ideal assignments of member to function and member to team from a team member viewpoint.

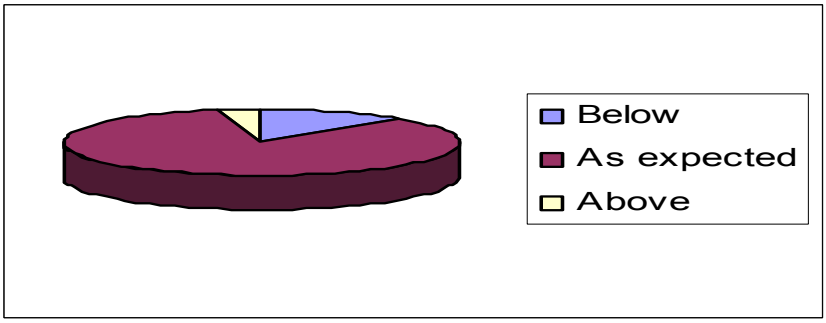
A question was formulated to evaluate participant perceptions on how individual performance can be considered a good indicator of learning. Answers showed that 13% of respondents considered this indicator graded below that they expected, 84 % considered individual performance as a good indicator to grade learning; and 3% of participants reported individual performance indicator attributed more grade than they expected to receive. Grades below and above expectations can indicate that luck factor is also present in such indicator. Figure 2 shows a graphic representation of team members' expectations about grades they should receive in terms of individual performance.

FIGURE 1 – Team members preferences to select teams and functions



NOTE: In the exercise the functions were self-selected and teams were random.

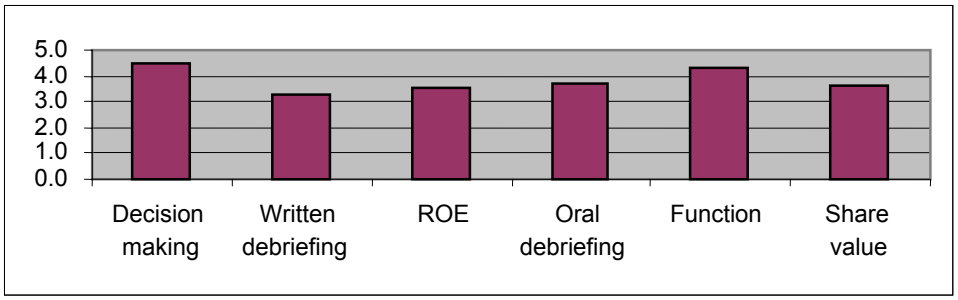
FIGURE 2 – Members expectations about grades received based on individual performance



NOTE: In terms of percentage.

A five-point Likert scale (1 = less important; 5 = more important) was used to evaluate individual performance in relation to other traditional grade indicators. Individual performance achieved the second highest evaluation with a score of 4.3, slightly below the presence on decision making process (4.5). Other indicators were written debriefing (3.3), oral debriefing (3.7), return on equity (3.5), and share value (3.6). Figure 3 shows a graphic representation of the importance of each grade indicator used in the business simulation course according to its participants.

FIGURE 3 – Importance of grade indicators from a team member perspective



NOTE: Using a five-point Likert scale (1 = less important; 5 = more important).

From an instructor perspective it was observed a more individual engagement in decision making process after the individual performance was introduced. Trade-offs between functions were more apparent and conflicts emerged. Absenteeism drooped to virtually zero after the introduction of individual performance assessment.

CONCLUSIONS

Present methodology was not devised to substitute existing grade indicators, rather to complement them. Academic grades, such as oral and written debriefing, or traditional performance indicators, such as net income, return on sales, or return on assets, must coexist. Furthermore, individual performance and company performance should be integrated. In doing so, members can be faced with real dilemmas of making decisions in self-interest or in company interest. Therefore, main methodology contribution is providing an individual performance assessment, both with academic and practical implications.

First empirical results were promising. Students were very confident about this additional performance measurement; and the instructor has added an instrument to assess students individually by their managerial performance. However, more studies are necessary to gather evidences of internal and external validity of this methodology, both in terms of representational and educational validity, as suggested in Feinstein and Cannon (2002). Future researches in the field can take many directions as follows:

- Evaluate the relationship between individual performance and learning achieved in the specific function being managed.
- Verify if the introduction of individual performance assessment improves simulated company performance as a whole.
- Study the impact of changes in participant function within the same team on participant learning process.
- Study self-interest versus company interest priority in decision making using individual performance.
- Study the impact of participant changes among simulated companies (with or without function changes) on team motivation and cohesion.

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