International Journal of Engineering Education Vol. 27, No. 3, pp. 610–618, 2011
Printed in Great Britain

0949-149X/91 $3.00+0.00

Acquiring Negotiating Skills by Playing in Project Engineering*

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Negotiation is defined as a joint decision-making process of two or more parties working together to reach a mutually acceptable agreement on one or more issues. Negotiating is not likely to be taught in conventional classrooms with expositive methodology, as students usually find this boring and insufficiently motivating for them to participate actively. The role playing method is better suited to improving trainees' skills. In this technique, students are asked to role play with others and assume roles in an adapted engineering negotiation. They are given some common information about the scenario, the issues to be resolved or optimized (i.e., the price of a material) and some confidential information that it is unknown by the others (their company negotiation position, etc.). Accepting that role playing is the best method by which to improve negotiating skills, there is a need to test whether combining this kind of game with quickly-provided theoretical knowledge of the principles of negotiation (negotiating positions, kinds of negotiators, etc.) would significantly improve the trainees' results. The purpose of this paper is to describe the research done with students at the ETS of Industrial Engineers of the UPM where a group was homogeneously divided into an experimental and a control group. Both groups of students were asked to participate in three negotiation role plays. The main objective of the experiment was to determine the adequate mix of playing sessions and theory necessary to maximize the students' negotiating skills.

Keywords: negotiating skills; learning by playing; engineering education

1. Negotiation in engineering education

Negotiation is a very important fact in normal life activities, but has become a key facet of engineering work and projects. Negotiations take place continually at any stage of a project and, so, the ability of engineers and managers to effectively carry out a negotiation is crucial for the success or failure of projects and businesses [1–4].

Negotiation is defined as a joint decision-making process of two or more parties working together to reach a mutually acceptable agreement on one or more issues [5]. It involves communication, direct or tacit, formal or informal, between individuals who are motivated to come together in an agreement for mutual benefit [4].

Although it is important for both parties to reach an accord, they are often not willing to cooperate or exchange information, because they fear that their counterpart would opportunistically use the information that they reveal [6]. Negotiating partners need, therefore, to balance cooperative actions with competitive actions, a situation that is usually referred to as the negotiator's dilemma [7–8].

While negotiations take place in all domains of life, the basic structure of negotiations in different contexts is fundamentally the same, with the following common characteristics present [6]:

(1) there are two or more parties involved;
(2) the parties can reciprocally and directly exchange information, whether honestly or not;
(3) the parties can be creative and cooperate in arriving at a joint decision;
(4) the payoff to any party depends either on the consequences of the joint decision or variables external to the negotiations.

The analytic approach of negotiation fact [3] is based on three major fields of study, all of which are related to the ideal of rational decision-making—game theory, decision analysis and behavioral decision theory.

Quality, schedule and other facts are subjects to be negotiated, individually or in part or as a group, in engineering transactions. However, price and delivery time usually are the most important subjects in the majority of negotiations, especially in construction projects [8]. When the highest price that the buyer is disposed to pay is greater than the lowest price the seller can accept, agreement is possible. The range between these two prices is called ZOPA (Zone of Possible Agreement) [4].

Another concept generally utilized in negotiations is the BATNA (Best Alternative to a Negotiated Agreement) [3]. It can be used as an effective way to establish the reservation price [9]. The act of establishing a realistic reservation price based on BATNA before a negotiation takes place, not only can increase the possibility of a successful deal, but also can improve one's confidence and bargaining power at the negotiation table. BATNA is even more useful when several issues are included in the negotiation, since different ZOPAs would exist and

* Accepted 15 October 2010.

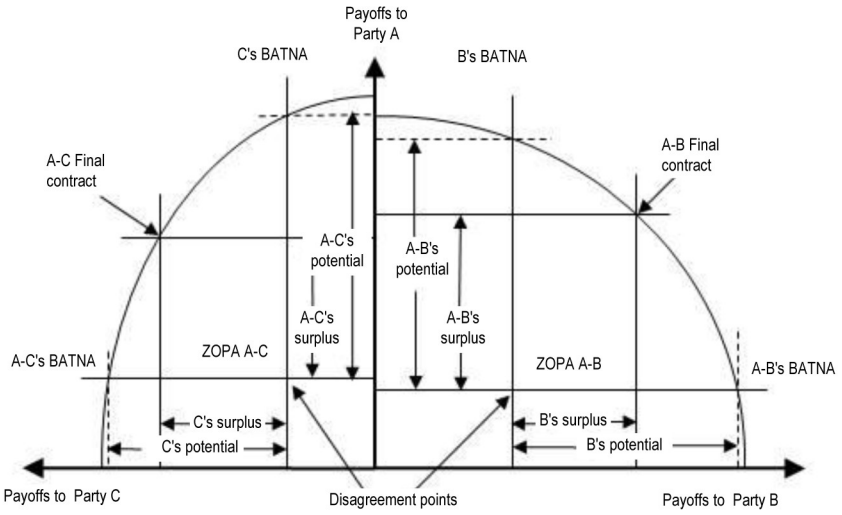

Fig. 1. Schematic illustration of the negotiation analytic approach.

the negotiation process would become more complex (see Fig. 1).

By analyzing ZOPA and BATNA graphics, it is possible to evaluate the bargaining level and evolution of one or all parties taking part in negotiations [10, 3, 11]. It is also possible to analyze tactics and negotiating models and even predict future behavior [12–13, 7].

Although negotiating skills are extremely important for engineers, they usually receive little attention in career programs, as it is generally accepted that these kinds of skills can be learned only through experience and observation [13, 7, 14, 1, 12]. Negotiating is not likely to be taught in conventional classrooms with expositive methodology, as the students usually find this boring and insufficiently motivating for them to participate actively [4, 15].

2. Learning negotiations skills by playing

The role playing method is generally recognized as more suitable for improving trainees' skills [13] than the lecture method. With this technique, the students are asked to play with others and assume roles in a hypothetical engineering negotiation. They are given some common information about the scenario, the issues to be resolve or optimized (i.e., the price of a material), and some confidential information that it is unknown by the others (their company negotiating position, etc.).

There are some computer tools for group negotiation (i.e., on the internet) and automated negotiation systems that can help one to optimize one's bargaining skills [1, 4, 15]. Although these tools can be very useful for professional improvement, face-to-face role play with other students is more enriching for student learning [13].

Accepting that role playing is the best means for improving negotiating skills, there is a need to test whether combining this kind of game with quickly-provided theoretical knowledge on the principles of negotiation (ZOPA's principles, negotiating positions, kinds of negotiators, BATNA, etc.) would significantly improve the trainees' results.

The authors' main objective was to evaluate the adequacy of mixing playing sessions and theory to maximize the students' negotiating skills. This was accomplished by research carried out with the participation of students at the School of Industrial Engineers of the Technical University of Madrid (UPM). The experience was integrated in the subject 'Construction and Industrial Architecture, I' given in the seventh semester, as a complement of the topics where construction project definition, agent roles and responsibilities or kinds of contract are explained. This is the first students approach to the construction project needs, and the learning will continue with other subjects as for example 'Projects in Engineering' and 'Integrated Management of Construction Projects'. The practical program was evaluated, so an extra point was given to all students that actively participated. In addition of that, a total of four 'awards' were given to the best negotiator as individual agent, and the best negotiator group.

To measure the natural improvement of students' skills when they participate in a negotiating role play session several times with and without previous theoretical knowledge, a pre-defined scoring system was used, combined with a record of the time that the negotiators took to reach an agreement.

The results will be used to develop a brief package of information on negotiating for post-graduate engineering studies.

3. Methodology

3.1 Role play scenarios

For the negotiation role playing, each team was formed by three participants who played different roles (Agents A, B and C), that involved different degrees of complexity. The role playing was conducted three different times, changing the conditions and making the ZOPA smaller each time so that the negotiation became 'more difficult'.

The role of each participant, as well as the initial conditions, was as follows:

- Agent A is a construction company project manager. He is making an offer for bridge construction that needs the participation of two subcontractors (agent B as steel supplier and agent C as ready-mix concrete supplier). The project's release date should be March 1st of 2010, and it is expected that the work assembly on the site will begin on April 1st of 2010. Materials may not be stored on the construction site before this date.
- Agent B is the production manager of a company that manufactures steel girders. This company has the capacity to make a maximum of 5 IPE1000 girders daily at the standard cost. The cost of production of each of the girders is 700 € and it will be possible to produce more girders at extra cost when needed and justified by the project. He will also subcontract to a new supplier if needed.
- Agent C is the production manager of a ready-mix company. He has limited production capacity and will have to subcontract to a new supplier if he cannot meet the time delivery needed by agent A.

Three different scenarios were created using different Zones of Possible Agreement for price, timing, quality, etc. Each successive scenario had a smaller ZOPA so that it became more difficult for the team to reach an agreement. Table 1 shows the information of the different scenarios for negotiation each day.

In Fig. 2 it can be seen how the ZOPA has changed through the different scenarios. The variations per day in the production cost are shown in the figures. As planned, Agent C has an easier price-time range; in addition the price-range for days 2 and 3 were similar. Agent B's risk of being responsible for a failure to reach an agreement is higher on day 1 than day 3 (the slope of the production cost line is higher so that a mistake in the delivery day will make it difficult for the other agents to accept an offer). Day 3 is the most difficult scenario for Agent A to reach an agreement since it has a range of only a few days.

3.2 Role play planning

Figure 3 shows the methodology followed with students at ETS of Industrial Engineers at UPM.

Table 1. Role playing negotiation scenarios

		Day 1	Day 2	Day 3
Agent A	Bid price limit	250.000 € total 100.000 € fixed cost	240.000 € total 100.000 € fixed cost	250.000 € total 100.000 € fixed cost
	Delivery time	65 days	61 days	58 days
	Bonus for objectives	Reduction of delivery time, offer increases by 600 €/day Agent will increase the bonus 20% of offer increment	Reduction of delivery time, offer increases by 550 € Agent will increase the bonus 20% of offer increment	Reduction of delivery time, offer increases by 500 € Agent will increase the bonus 20% of offer increment
	Constraints	Restrictions on storing cast girders 10 days for girder assembly		
Agent B	Job order	100 IPN 1000 girders		
	Offer price	5 girders/day 700 € 2 extra/days and weekends 770 € Subcontracted girder 1.800 €	5 girders/day 700 € 2 extra/days and Saturdays 770 € Subcontracted girder 1.600 €	5 girders/day 700 € 2 extra/days and Saturdays 770 € Subcontracted girder 1.200 €
	Bonus for objectives	Agent will increase the bonus by 10% of offer increment		
	Constraints	Storage of casted girders		
Agent C	Job order	1.000 m^3 of concrete		
	Offer price	150 m^3/day 40 € 250 m^3/day 55 €	135 m^3/day 40 € 250 m^3/day 60 €	125 m^3/day 40 € 250 m^3/day 60 €
	Bonus for objectives	Agent will increase the bonus by 5% of offer increment		
	Constraints	Product with a working time of only 1½ hour; cannot be stored		

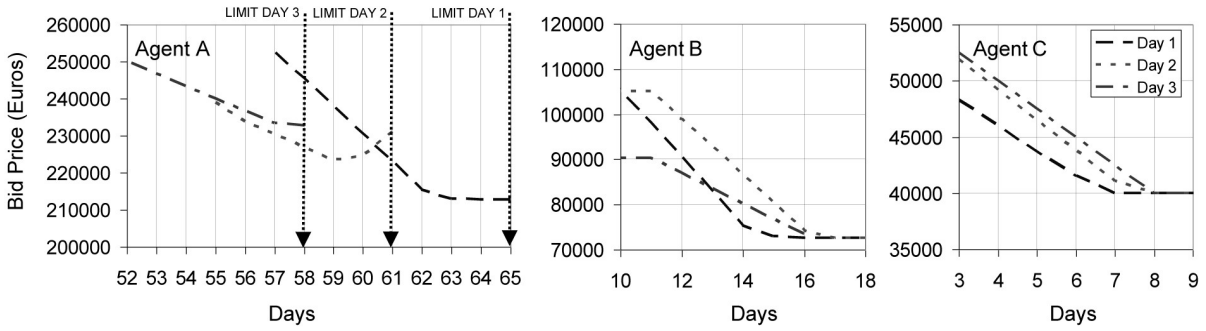

Fig. 2. ZOPA for each agent in scenarios 1, 2 and 3.

Eleven teams were involved in the role playing. Roles were distributed according to the students' experience, since it was understood that the difficulty of the roles differed and there was a time limit for negotiations.

Six teams formed the Experimental Group (EG) and five were used as Control Group (CG). Both groups were asked to participate three times in a negotiation role play related to the construction project presented.

At the end of each playing session, each student completed a questionnaire. The completed questionnaire includes all of the student's information regarding the results of the negotiation, perception of the difficulty to reach the agreement, perception of the negotiators and level of satisfaction with the agreement. Between the initial day and the final day students received information about the development of the groups' skills, but not about their own development.

After the first session, the EG received theoretical instruction (F) of one hour about the principles of negotiation. The objective of providing this theoretical instruction was to determine the effect it would have on the next negotiating sessions and whether the students who attended the class had develop better negotiating skills and obtain better results.

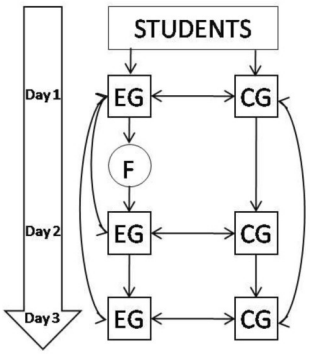

Fig. 3. Methodology used to evaluate the improvement of both the experimental group and control group.

The whole purpose of negotiating is to find out what each party really wants and what he or she is willing to give —and give up—to get it. During the introduction of the course the framework of the negotiation was explained and also the skills and qualities that a good negotiator needs. Several aspects were noted:

(a) The first step in carrying out a successful negotiation is that it needs to be prepared properly. The preparation must be appropriate for different negotiating situations, looking at the purpose, the desired outcomes for both sides, who will participate and what is known about them, including the interests and positions of all parties. The difference between an interest and a position and why it's important to separate them is highlighted.
(b) The different roles played during the negotiation were explained.
(c) A strategy must be created that will cover the entire negotiation. A strategy is the comprehensive plan developed to help us to achieve an important goal. It includes all of the key steps that will be followed to help 'capture' the ultimate objective.
(d) A tactic, on the other hand, is a very important component within that strategy. It consists of any moves, countermoves and adjustments that could be employed as one side attempts to gain the best possible outcome at any given moment. Different negotiation tactics were presented during the course.

Therefore, at the heart of the negotiation process is the art of asking for and making concessions. Concessions are the terms, conditions and money that may be traded during the bargaining process in order to reach a win-win agreement. It is the exchange of concessions that moves a negotiation from opening to agreement. The negotiation must be ended when there is a win—win agreement. It was explained that negotiation is 'an art that must be practiced.'

4. Results

4.1 Results of the bid price and delivery time

Even though at least four iterations were needed to reach an agreement, only final results will be presented. The single observation of the data shows that, if one individual agent has a profit higher than 50%, the agreement will not be valid. There is a change from day 1 to day 3 where individual profit is more controlled. Although students used all of the time available for negotiation on days 1 and 2, they were able to reach agreement quickly on day 3, with only one group needing the entire 60 minutes available. It can be seen that, although on no day did all teams reach a valid agreement, the approaches improved day by day. On the first day three groups were unable to reach an agreement. On the second and third days, four groups and two groups, respectively, were unable to reach agreement. Small mistakes in considering dates were made on day 3.

Figure 4 plots the individuals' bid values in order to better show the general results. The upper limit of the bid price represents the best agreement, while the lower limit represents the worst agreement for each agent. It is important to note that each price that a team bids is for a specific time period (e.g., a higher price may be required for a shorter period) and this period is different each day. It may be noted that on day 3 there was more creativity in the offers, probably because students felt more confident in the game.

Between day 1 and 3 there is a clear evolution since the bids prices are closer to the average and between the best and average agreement.

The evaluation of negotiating skills will be based on:

- Individual bid price and profit per agent taking into consideration the price-time optimum per agent;
- Team bid price and profit, considering the optimum combination per scenario.

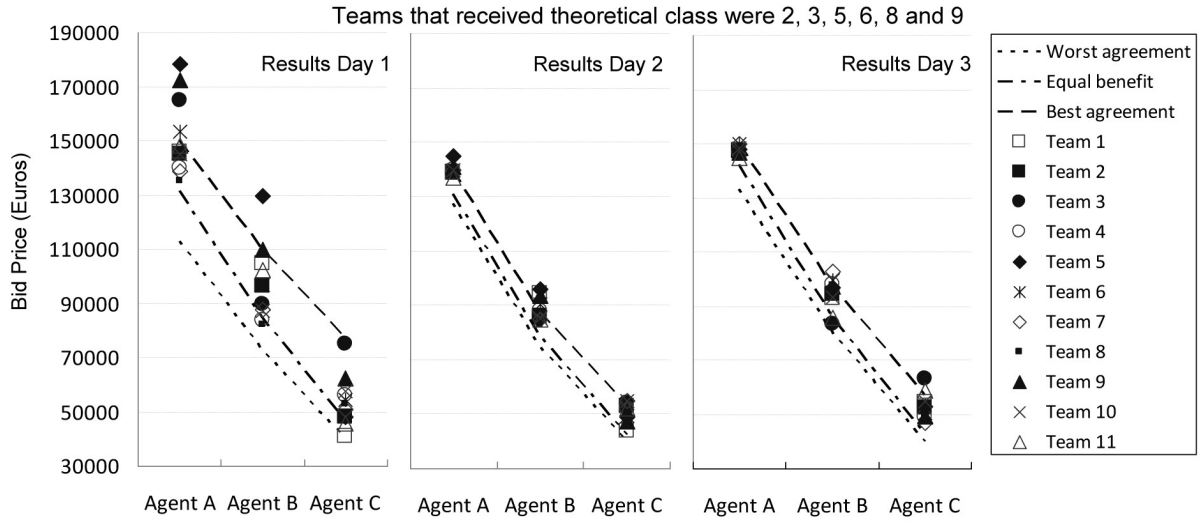

Fig. 4. Negotiation bid prices.

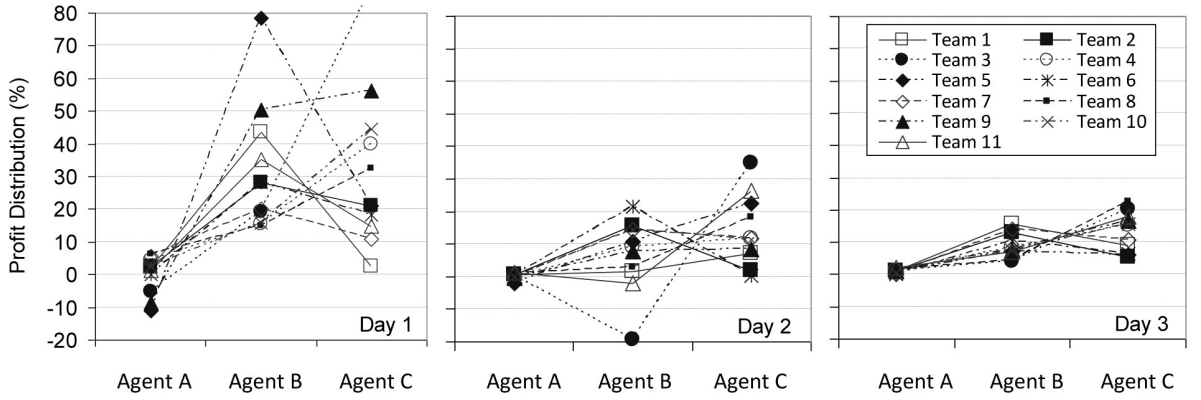

Fig. 5. Profit distribution.

Figure 5 shows the profit distribution. First, it can be seen that on day 1 there was a great difference in what agents offered, makings it difficult to reach an equitable agreement. On day 3, agent A for all teams has a very close profit and agents B and C make a profit of between 4 and 16%. Since all results in the graphs are represented together, there is no indication of which teams have received theoretical instruction and which have not. Overall, however, there is an indication that the experience gained by role playing has improved negotiating skills.

The results of teams that were unable to reach a valid agreement do not appear in Fig. 6. The evolution of skill development from day 2 to day 3 in the teams that were able to conclude a satisfactory negotiation is better for the teams with theoretical knowledge. It is important to point out that the teams selected to receive the classes were those that had the worst results on the first day—the teams that initially had poor negotiating skills. However their final results are very similar or even better than those of the other teams.

4.2 Results of the survey of negotiating skills

Figure 7 show the results of the students' perception of the difficulty in setting the bid price and delivery time in a format of box-and-whisker plots, with one for each column of data. The rectangular part of the plot extends from the lower quartile to the upper quartile, covering the center half of each sample. The center lines within each box show the location of the sample medians. The plus signs indicate the location of the sample means. The whiskers extend from the box to the minimum and maximum values in each sample, except for any outside or far-outside points, which will be plotted separately.

Generally, all students perceive less difficulty on day 3 than day 1, even though the scenario for day 1 was easier. Also, it can be seem that students that have received some training perceive less difficulty.

Students perceive a greater difficulty in setting the bid price than the delivery time, although both parameters are related, as can be checked in Fig. 2. Students that have not received any theoretical training perceive the same difficulty in fixing the bid price on day 3 as on day 1. However, students who have had theoretical training perceive the difficulty to be less. Teams that have received theoretical training not only perceive a minor degree of difficulty, but also get closer to the optimum in bid prices (see Fig. 6). After taking into consideration the evolution of different agents, it is slightly more

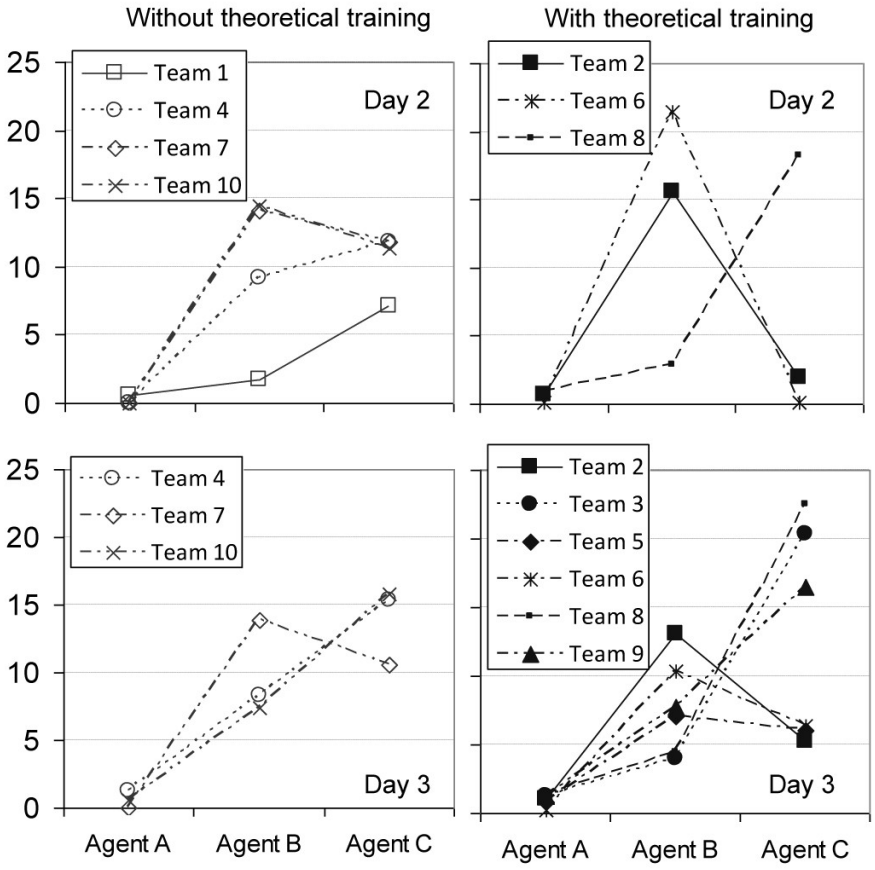

Fig. 6. Effect of theoretical knowledge on negotiating results.

difficult for Agent A on day 1 to set the time than the price, but not on the other days when the scenario is tighter and negotiation harder.

Students perceive other agents to be equal or tougher negotiators. However, there is no agreement between the benefit they receive and what others perceive that benefit to be.

After day 2 and 3, the students were asked to answer a survey of seven questions, related to their communications skills, an analysis of the strategy carried out, how the tactic used has moved the negotiation (changing delivery time or bid price), an analysis of the interests of the other parties and how the theoretical training received had influenced their position during the negotiation.

A principal component analysis was carried out to verify that the questions were independent. Results show that students who are perceived to have

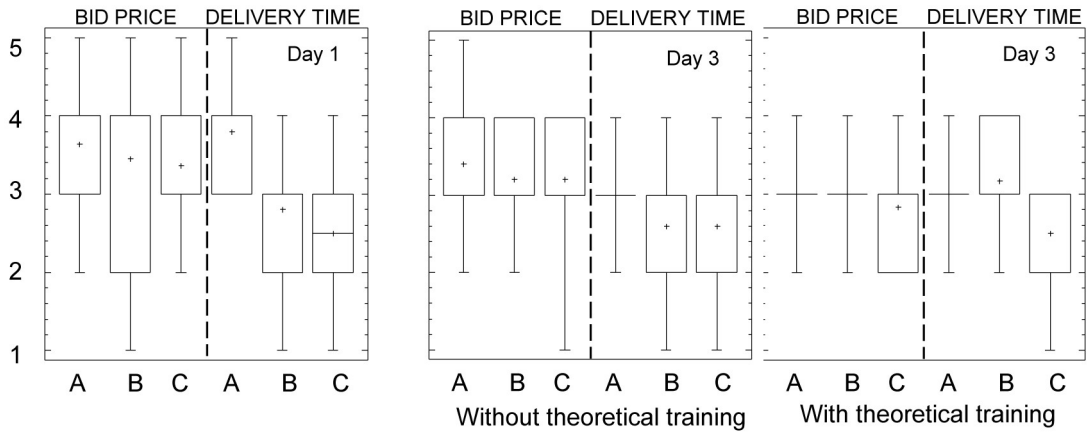

Fig. 7. Perception of difficulty in fixing price and time.

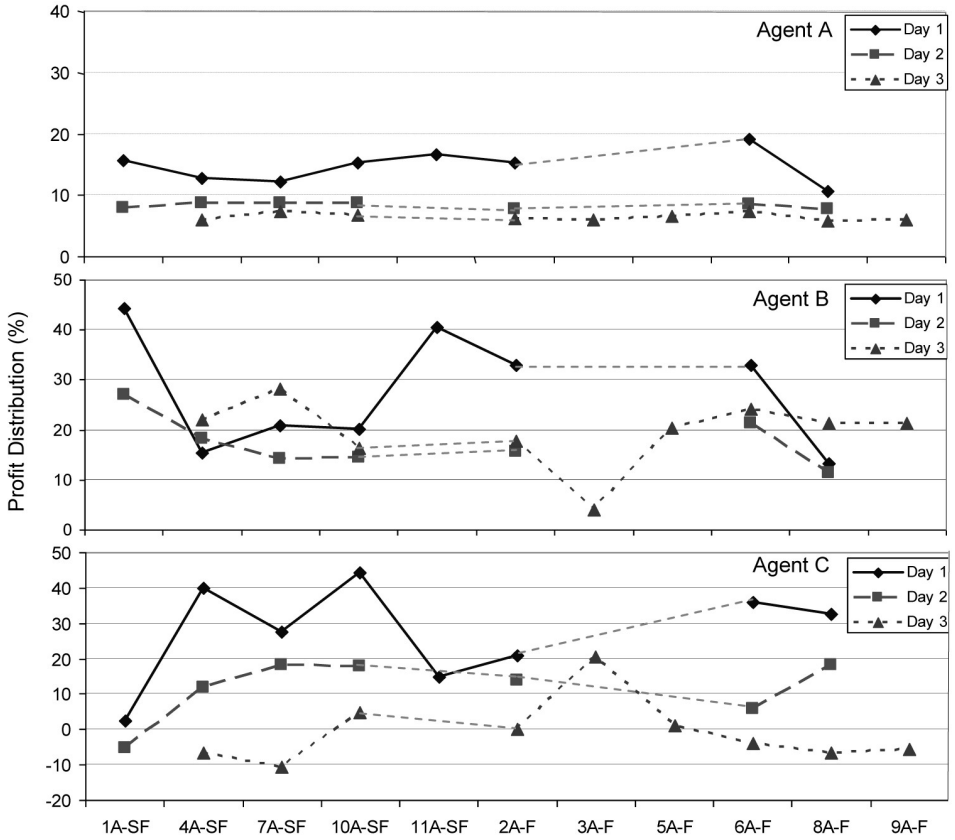

Fig. 8. Distribution of profits in optimum negotiations.

good communications skills also are the same ones who analyze the strategies of all parties involved in the negotiation.

5. Discussion: evaluation of students learning by role playing

From the values of plots in Fig. 8, where only valid negotiations are plotted (dash lines fill the gaps left by invalid negotiations), it can be noted that development of skills by experience brings a more homogeneous benefit distribution. Students playing the role of Agent A learned that their difficulty was in setting the time delivery and that they did not have much leeway in playing and so they had to obtain the best agreement for agents B and C. That is why their profit only slightly exceeds 0%. Students playing the role of agent B also were able to obtain a more homogeneous distribution. Even more important was the progression of those who had received the theoretical training. Students playing the role of agent C are the ones that played harder on day 3 since they were able to get the highest individual profit.

It is important to point out that the teams ended with an agreement that was far from optimum since agent C negotiated a later delivery than optimum and so, as proved by the negative values, their teammates were unable to negotiate a better agreement.

Although in the survey students considered their negotiation to be collaborative and not competitive, results prove that Agent C had a very competitive strategy, especially on day 3 for all teams, with and without theoretical training.

6. Conclusions and future developments

In addition to detailed technical knowledge and performance skills in engineering education, other personal and contextual skills (like negotiating skills) are important for these students and require engagement, communication, creativity, understanding, conflict resolution and decision making. The opportunity to develop these skills often is unavailable to students until they become employed. Introducing students to such experiences earlier can foster the development of these abilities.

This experience has demonstrated that learning by playing is an effective way for student learning in the negotiation subject area. It can be an important tool for improving engineering student performance, as well as motivating and enhancing other non technical abilities. The combination of playing and training has shown that students without particularly good negotiating skills at the beginning of the experiment attained better final results than those who have natural negotiating skills, but no benefit of training.

As confirmed, playing is a method of instruction that challenges students to learn how to work cooperatively in order to seek agreement in real engineering problems. It prepares them to think critically and analytically and to use appropriate skills. These problems are used to engage students' curiosity and initiate the learning of the subject matter. The independent research and learning aspects of these role plays provide the students with the skills necessary to identify, research and supply the missing knowledge for the types of problems that they may encounter during their professional lives.

The perception of both the students and teachers is that the learning approach tested was valuable and more productive than lecture-only approaches, despite the fact that it required greater effort than the classical method. Even though none of the question of the survey was related to get information regarding how they liked the experience, the feedback from students was: a) A practical class totally enjoyable; b) They get to know each other better, what they can use to other learning works in the program. A final survey will be incorporate in next experiences in order to get an overall feedback.

This experience could be adapted to other courses by changing the specific area like complaints and suppliers management. Our immediate plan is to complete the experiment by developing more personal and contextual skills for engineers: leadership skills, a results-orientation and ethics, among others. Also, scalability characteristics will be analyzed by running the approach with nearly two hundred students.

Acknowledgments—The authors express their appreciation for the efforts of the 4th year students who are majoring in Construction at the ETSII Universidad Politécnica de Madrid.

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