DRP GAME: NEW TOOL TO ENHANCE TEACHING AND LEARNING IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

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***Abstract**: This study presents a new logistics and supply chain management educational game called DRP Game, which enables players to cooperate within teams and practice the logic of distribution requirements planning (DRP) method. This game has been developed and applied at the Faculty of Organizational Sciences, University of Belgrade, as a supplement to traditional teaching about distribution channels and DRP topics within Business Logistics course over several years. The DRP Game is offered free and can be easily tailored by interested instructors. Meanwhile, the results of game usage evaluation showed that students were very satisfied with the DRP Game and that they would like to use more games like this in the teaching process. The results of this study are useful for both academics and practitioners interested in training and education in the field of logistics and supply chain management.*

***Keywords:** game, distribution requirements planning, logistics, supply chain management.*

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1. INTRODUCTION

The educational institutions have a huge responsibility to prepare students for dynamic logistics and supply chain management (SCM) profession. They must continually analyse and question their study programs and ways of teaching in order to enable acquiring appropriate knowledge, skills and abilities to the future logistics and SCM professionals. Games usage in combination with other teaching approaches is one promising way to improve efficiency of courses related to the field of logistics and SCM.

In general, 'a game is any activity with at least one established objective and an element of competition among players' [3]. It places players into competition against each other or against standards [11], [3]. A game can be considered as an extension of simulation [12] and very often, a game comes out of simulation with the addition of some elements of competition [11], [3]. They can have some advantages over simulations such as determining the adequacy of existing structures, policies or procedures; bringing more effective communications; enhancing learning; preparing people for coping with future situations; generating new ideas, and projecting uncertainty, according to the same sources. According to [12], games are more appropriate method than a simulation for learning and strategic-decision making in the macroscopic logistics and SCM environment. The using of games and case studies in addition to traditional lectures for teaching SCM is advocated by [13]. In [7] is pointed out that most logistics and SCM educators use at least one game, simulation and/or interactive exercise in addition to other teaching methods such as lectures and case studies.

Logistics and SCM educational games allow students (players) to play different roles, e.g. a logistics manager, a supply chain manager, a distribution network designer, an inventory manager, a logistics engineer, etc., in an environment 'without real risks' that consists of virtual entities, such as products, factories, transport vehicles, distribution centers, wholesalers, retailers, etc. There are a number of logistics and SCM games that can be applied in teaching and learning processes. They are diverse in terms of scope, topics, type, number of players, utilization costs, etc [3]. Therefore, they can be classified according to their scope from a microscopic orientation (such as some parts of a logistics system, such as a machine, transportation vehicle, etc.) to a macroscopic orientation

concerning a total supply chain, based on [12], [3]. The presence or absence of some logistics and supply chain topics can be related to the certain game. In terms of type, the logistics and SCM games can be classified as non-computer and computer games, and more concretely, as manual, software, and online games. They differ in number of players which can be included in the game and often the minimal and/or maximal number of players is limited. When attention turns to costs, they vary from free games to very expensive commercial games.

At the Faculty of Organizational Sciences (FOS), University of Belgrade, the logistics and SCM games have been employed as complementary teaching tools in courses of Business Logistics and Supply Chain Management. The Business Logistics course is compulsory and Supply Chain Management is optional in the undergraduate program Operations Management. The aim of the Business Logistics course is to provide students with knowledge and skills in the fundamental concepts and methods of logistics management. It is a one-term course taught in the fifth semester. The aim of the Supply Chain Management course is to provide the students with the understanding of strategic importance of supply chains in the global environment, and with the methods, tools, and activities necessary for efficient and effective SCM. It is a one-term course, taught in the eighth semester. In order to select and apply the most suitable games according to the requirements of these two courses the serious analyse of the 'market' of logistics and SCM games was conducted [3]. The lack of educational tools for actively supporting the topic about Distribution Requirements Planning (DRP) took us to the idea to develop a new game, named DRP Game. The aim of this paper is just to more closely represent this new logistics and SCM game, which we believe can be useful for interested educators.

The remainder of the paper is organized as follows. In the next section, a brief theoretical background about DRP is given. Then, a new logistics and supply chain management educational game called DRP Game is presented. The results of evaluation the DRP Game from two generations of undergraduate students are then shown. Finally, some concluding remarks are offered.

2. THEORETICAL BACKGROUND

DRP is a time-phased replenishment approach for determining finished goods inventory requirements within the distribution network and periodically generating new shipment plans [4]. It is based on forecasting demand at the lowest level in the distribution network and consolidating demand information in reverse until the highest level in the network has been reached. DRP can be used across company boundaries as well as within them [14, p. 181]. The main purpose of DRP is to ensure that the right finished goods in the right quantity reach the demand centres (e.g. retail stores, distribution centres) at the right location and in the right time [8]. The potential advantages of using DRP are inventory reduction in the distribution network, better customer service, cost reductions and compatibility with other systems within the supply chain (e.g. Material Requirements Planning (MRP), transportation planning) [4]. On the other side, the disadvantages include relatively high implementation costs and system nervousness which can result in highly uncertain environments, according to the same source.

DRP systems use logic similar to those used in Material Requirements Planning (MRP). 'They generally function according to the 'pull' principle, although there are some DRP systems that function according to the 'push' principle. Pull DRP functioning can be explained by the following steps:

1) Identifying the projected requirements of the lowest distribution network levels by planned periods, according to the forecasted demand for items;
2) Generating report – schedule of the planned orders, with application of MRP logic, and issuing purchase orders on the next higher level within the distribution network;
3) Calculating the projected requirements by planned periods on a higher level, influenced by the orders issued by the lower level; and
4) Going back to the second step, until the highest distribution network level has been reached', [8].

DRP was developed by Andre Martin during the 1970s and 1980s. The first two implementations of DRP systems were in American Hardware Supply (currently a part of True Value) and Mass Merchandisers Inc (now part of McKesson) in 1983, also owing to Martin, according to data given in [6]. Further extension of DRP included planning of the important resources within the distribution system, such as warehouse space, human and financial resources, cargo vehicles, etc. The term used for such DRP extension was Distribution Resource Planning (DRP II). Today, DRP (or DRP II) is usually included as a module in the Enterprise Resource Planning (ERP) systems. In the last years,

Andre Martin together with his colleagues Mike Doherty and Jeff Harrop have been working on the development of wider extension of DRP known as Flowcating (see e.g. [9], [6], [8]).

In the educational environment, the MRP and DRP are important topics in courses related to logistics and supply chain management. Several educational games and software systems for supporting the learning of MRP are developed. For example, the "In-Class Manufacturing Game" [1], the "Lean Manufacturing Simulation Game" [5], the "HECOpSim" game [10], and the well-known software systems like "WinQSB" [2] and the "POM-QM for Windows" [15] which offer a module for processing the MRP data. On the contrary, the lack of educational tools for actively supporting the topic about DRP is noticeable. This was the main reason why we were developed a new game (named DRP Game) for practicing the DRP logic in the previous years.

3. DRP GAME

The DRP Game is a role-playing simulation for practicing the logic of Distribution Requirements Planning (DRP). This game enables students to experience DRP environment by playing different positions in a distribution network. The distribution network consists of one brewery which distributes products to several retailers through wholesalers (Figure 1). Each player is the member of team which gets and takes the role and responsibilities of one distribution network participants: brewery planning manager, wholesale purchasing manager or retail purchasing manager. The teams are distinguished by colour and at the beginning of the game each player needs to find his team members. Teams are competing in developing the plan of distribution requirements for a 7-day planning period. The members of team in the roles of retail purchasing managers have the task to release the »summary« purchase order for a 7-day planning period to appropriate wholesaler based on orders from known customers and demand forecasting. The members of team in the roles of wholesale purchasing managers have the task to release the »summary« purchase order for a 7-day planning period to brewery based on »summary« purchase orders obtained from retailers. The member of team in the role of brewery planning manager has the task to release the »summary« production order for a 7-day planning period to Judge (this role is envisaged for instructor) based on »summary« purchase orders obtained from wholesalers. The criteria for determining the winning team are: accuracy and time. The possibility of getting the role of observer in the game is also anticipated, and the students-players in these roles have the task to release the 'secret' report to Judge.

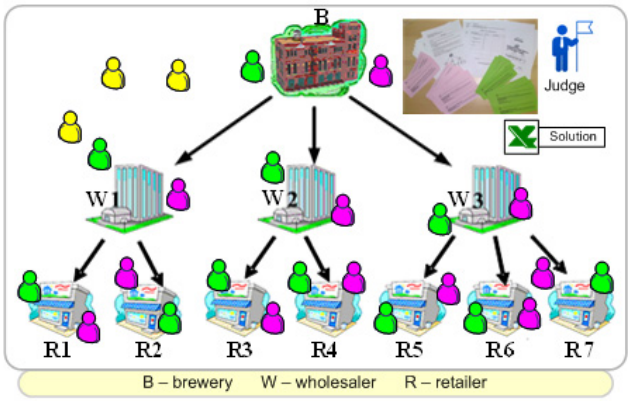

Figure 1. DRP Game environment

One game usually requires a five to ten minutes of presenting the rules of the game, about twenty minutes of actively playing and more than half an hour of discussion. The general prerequisite for this game is the players' previous knowledge of DRP logic and basic lot size models (Lot for Lot (LFL) and Fixed Order Quantity (FOQ) are mandatory). The instructor can create a number of variants of this game by changing the number of teams and/or number of members per team, the number of observers and/or the DRP problem.

The DRP Game is played with the use of the following paper based documents: DRP Game Instruction, DRP calculation tables, »Summary« reviews of orders from known customers and demand forecasting, »Summary« purchasing orders, »Summary« production orders and »Secret Mission Reports«. Solution for discussion of team results is provided as an MS Excel document. Diplomas and optional other prizes for the members of winning team are also anticipated.

The DRP Game can be useful for supporting topics such as distribution channels, DRP, integrated MRP-DRP system and other similar topics. The DRP Game is available free of charge and all the files that are required for an instructor to apply this logistics and SCM game can be downloaded from http://fon.fon.bg.ac.rs/~cvetic/drpgame.html.

3.1 Students' viewpoint of the DRP Game

The DRP Game has been used for active support to the DRP topic in the undergraduate Business Logistics course at the FOS for several years. Its evaluation was conducted during the winter semesters of 2011/2012 and 2012/2013. The post-game questionnaire consisted of two parts of statements, one for evaluation of the game and the second one for the evaluation of instructor. Students

were asked to rate their experience with playing the game on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The total of 25 students from one generation and 34 from another participated in the evaluation of the game. During this evaluation, the instructor was rated with very high scores and these results are omitted. This might be explained with the previously well established relationships between students and instructor.

The results of evaluation the DRP Game are presented in the form of a radar chart in Figure 2. Both generations of students (hereafter, G1 and G2) gave the highest scores to the statement that they "would like more games like the DRP Game to be used in teaching processes" (G1: mean (M) 5.00; G2: M 4.94, variance (V) 0.06, standard deviation (SD) 0.24) and that the "inventory management in a distribution network with the help of the DRP Game is interesting" (G1: M 4.92, V 0.08, SD 0.28; G2: M 4.94, V 0.06, SD 0.24).

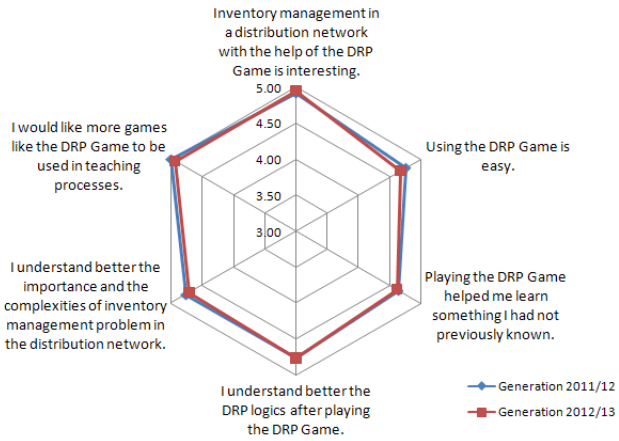

Figure 2. Results of DRP Game evaluation (mean values)

Also, students were very positive about all other statements in relation to the DRP Game usage. The following two comments received from students are emphasized. "The game is great. All praise. It develops team spirit." and "All the praise for introduction of such contents in the class!" Obviously, according to these results, learning and practicing of DRP logic were influenced by the DRP Game. However, these results should be taken with caution because it is possible that they were influenced by the fact that students knew that the game had been developed at the FOS.

3.2 Instructors' viewpoint of the DRP Game

The DRP Game is a very simple game which helps students to practice the logic of DRP in an interesting environment. Usually, during the reading of DRP Game Instruction some students are laughing when they come to the description of the roles of observer and Judge, and some of them look very confused with the rules of the game. After receiving other documents for playing the game, the common question from students is: "Can we freely walk in the classroom?". Upon receiving an affirmative answer from Judge, some students quickly begin to form teams, while others sit in their seats and still waiting for someone to find them. As time passes, students with better knowledge of DRP start to help other teammates and check their results. When one team completes the game and submit the results to the Judge, the 'little disappointed' players from the other team/teams start to even more concentrate on the accuracy of their solution. Therefore, it could be said that this game can show some aspects of students' nature in sense of prudence and competitive spirit.

When all teams submit their results to Judge, the observers have the opportunity to give the suggestion of winning team with accompanying explanation which includes comments on efficiency of achieving results, communication within a team, time, etc. Then, solution discussion starts from the lowest distribution network levels. As we moved closer to the proclamation of the winning team, the students increasingly cheer for their team and loudly comment. Sometimes, it is quite difficult to maintain order between different teammates in the classroom. After the end of the game, all students seem very satisfied.

The main disadvantage of DRP Game is time required to carefully prepare all needed documents. Any modifications in the number of teams and/or number of members per team, and/or the DRP problem required additional time for customization.

The best thing with the DRP Game, which we want to emphasize, is that since we apply this game in combination with lectures for supporting the topic about DRP, all students successfully solve tasks related to this topic on the colloquium and/or exam.

4. CONCLUSION

Games are a helpful and enjoyable supplement to other teaching approaches. Since the 1960s a number of logistics and SCM educational games have been developed in academic, military and commercial organizations. However, the lack of games for actively supporting the important topic about Distribution Requirements Planning (DRP) in the field of logistics and SCM was noticed, and hence a new game named DRP Game is developed.

The DRP Game is a role-playing simulation for practicing the logic of DRP which enables students-players to experience DRP environment by playing different positions in a distribution network. This game has been successfully used in the undergraduate Business Logistics course at the FOS over several years. The game is available free of charge to all interested educators in the field of logistics and supply chain management.

Some limitations of this study include small populations of students-players of DRP Game, the only one course at one faculty considered and evaluation conducted via only the post-game questionnaire. In our future work, the intention will be to examine the influence of this logistics and SCM game on students' achievements and provide the more comprehensive evaluation of the game from students' viewpoint. It is hoped that we will continue to further enhance and improve teaching and learning activities in courses related to the logistics and supply chain management.

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