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Exploring a Commercial Game for Adoption to Logistics Training

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Abstract. Supply Chain & logistics as a subject lends itself readily to game-based learning. SCM subject learning is primarily about decision making, logistics and strategic management of resources. Most of the serious games designed for SCM are used in a workshop setting, and much of the learning outcome is achieved through the debriefing part of the workshop, i.e., not as an integrated part of the game. However, many such serious games expose their internal mechanics too easily. This side effect coupled with high development costs and limited and often constrained assessment schemas are reasons for low uptake. Another aspect is that games age and thus can often not be used for a long period. The usage of commercial off the shelf games might be a solution, but it requires that the game can be modded to fit the intended learning outcomes in the course it should be used. This article reports on the work carried out to identify if such a game, not specifically designed for the specific curriculum of SCM, can be used or not.

Keywords: Serious Games, Commercial Games, Logistics Training.

1 Introduction

1.1 Serious Games in Education

In higher education, logistics courses and programs differ primarily in their area of emphasis and program degree. In a general business degree, courses typically cover a mix of finance, accounting, operations management, and economics. A more specialized degree in logistics management would have a curriculum focused, for example, on supply chain management, transportation, manufacturing, warehousing, or procurement; logistics courses relevant in engineering programs focus more on system thinking and the implementation of suitable systems and equipment. Despite the need to examine logistics as a complete system, logistics courses are still mostly addressed

at a theoretical level. Thus, a graduate's perspective remains narrow around logistic functions and their interactions that affect system performance. With respect to preparing a career in logistics, graduates face a steep learning curve to anticipate the impact of their decisions in a real-world environment.

This paper is to review a management-strategy simulation game for the purpose of Game-based learning (GBL) in logistics. While game-based approaches are not new, they offer a way to deliver an otherwise difficult subject. The gaming environment offers simultaneous problem- and practice-based instructional methods to create learning situations that further promote and develop critical thinking, where learning is extended from theoretical models as such, to their application in realistic settings. Reflection upon the appropriateness of the models then becomes essential [1–3].

For the subject on logistics, it is important for students to know how performance attributes and metrics [4] like the attributes SC reliability and flexibility and corresponding metrics [5] are defined and measured. Still, it is necessary to understand how these are generated in a process and how they can be monitored and controlled. The latter is difficult to grasp from a textbook, and thus more practical experiences in a course setting might be more appropriate [6–9].

The authors have experience in using serious games in higher education, such as the MIT-born beer game (and adoptions thereof), individual developments such as Sumaga – a beer game [10], Beware a SCRM game [11], Seconds – a game for understanding the interactions in supply network and distributed production [12] (no longer usable due to too old data in the processes) as well as other solutions (e.g., the SHORTFALL game, no longer playable because based on Flash technology). Ageing of games [13] as well as the need to facilitate courses on logistics and process management in (industrial) engineering and business administration motivates the authors to identify new serious games for their teaching environments.

1.2 Problem and Approach

Although solutions developed at and maintained by universities and research institutions are regularly a good choice due to their focus on specific educational objectives, these solutions may be lacking latest features and graphics as well as long-term technical support. In addition, most serious games for logistics and SCM are round based instead of a real-time simulation. Due to these challenges, the authors aimed to identify a commercial solution that can be used for their respective courses considering the defined learning objectives and the intended learning outcomes (ILOs).

Initially, the authors reviewed their courses' ILOs to ensure a necessary degree of consistency. In the next step, they explored different potential sources of both serious and commercial games left mainly with serious games and simulations that are text-based and where the simulation of production processes is left to a 'black box' and is not part of the actual game play; i.e., round-based games with simulation results being calculated between rounds vs. a building simulation (city-building style, not round-based) where the actual simulation is constantly running. The game Production Line offered the latter option and was therefore selected for further analysis against the ILOs. The analysis outlined in the following is also intended to support others that

consider COTS games for teaching purposes and to contribute to respective discussions in the community.

This paper explores the game Production Line (section 2) and presents the analysis whether the game can facilitate those ILOs the authors share between their respective university courses on logistics (section 3). The paper concludes with a discussion on how to adopt the game (section 4) and the next steps (section 5).

2 Background and Game

Several serious games are available to teach SCM and logistics. To the knowledge of the authors, most solutions draw a broader picture at a higher level of business, e.g., focusing on functions such as SCM, Finance, Marketing/Sales, limiting the way how production and processes are managed at a technical and operational level. In addition, simulations are often round based, i.e., in between rounds decisions are prepared by the player(s). Therein different approaches exist, either running over a defined period (e.g., SHORTFALL or The Fresh Connection [14]) or providing a result of a somewhat steady state as basis for the next round (e.g., The Blue Connection [15]). Solutions based upon the idea of a building simulation such as the popular SimCity game or similar were more difficult to identify. In such simulations, time is constantly running, and decisions must often be made under time pressure inherent to the game itself rather than being imposed externally by a facilitator.

The authors identified the simulation game Production Line© by Positech Games as a promising solution. Production Line resembles the design and development of a modern car factory. The game is designed as a single-player simulation game that provides a factory environment to build a production line. The underlying objective of the game is to constantly increase the efficiency of the production line to increase turnover, profits (to reinvest in research and technology) and ultimately gain more market share. However, different playing options such as sandbox or scenarios are available and may steer the player towards specific strategies. Scenarios are defined around a defined number of vehicles of specific car body types (sedan, SUV, etc.) that must be built within a given time frame and starting with a specific budget. Cars that are produced are to be sold at the market and revenues are used to finance running production, investments in the production itself as well as research and development for new vehicle technologies (e.g., new vehicle functions such as air conditioning) and improved production process (e.g., specialized operations in the paint shop and new robots). Fig. 1 shows a screenshot of the game during a virtual session with the building elements menu on the left and the actual car factory in the centre, in this case a simple production line set by the authors to test some of the functionalities and effects of player's decisions.

As stated on the game developer's website: "This game is designed to appeal to the efficiency geek in all of us, the person who cannot help but organize things for maximum performance" [<https://www.positech.co.uk/productionline/>]. Organizing and designing the factory (layout), assessing its (lack of) performance, designing and researching potential solutions, and eventually adopting strategies to overcome bottle-

necks and improve performance are not only tasks inherent to the game but also main tasks related to the authors ILOs as will be explained in the following.



Fig. 1. A screenshot from Production Line by Positech played by the authors during a test session in April 2022.

3 Educational Setting and Learning Objectives

The authors represent three different European institutions of higher education where they are teaching courses on logistics in either engineering-oriented or business administration undergrad programs (amongst others). The authors have all long experience in using different games as an integrated part of specific courses. So far both commercial-on-the-shelf (COTS), as well as serious games, have been used in both courses designed for game-based learning as well as in courses which have had the most lectures. In two of the institutions, Production Line will replace a serious game that is no longer maintained and thus cannot be used [16]. The integration of Production Line will vary both within an institution as well as from one institution to another. The usage depends very much on the topic and the flexibility of the curriculum. Therefore, in a first step, we need to investigate if the game will help the students in achieving the intended learning outcomes and if the play can be sufficiently flexible. It is our aim that we will use the game already in the upcoming academic year.

3.1 An introductory course on production logistics at the Royal Institute of Technology (KTH)

At KTH the game will be used in a course on production logistics (6 ECTS) [17] in the 3rd semester of the degree program (5 years) in industrial technology and sustainability and is mandatory. The game will be used as an examination moment with 1,5 ECTS and will address two out of six ILOs. It is one of 4 examinations. In previous years, two different games were used (shortfall and a beer game). Yet a game is needed that supports all aspects of ILO4 and 5. The intention is that the practical experiment of making a production line will better visualise all elements that play a role in the performance of production logistics as well as to let the students experience how different designs and the planning of a production line are affected by early decisions taken at the planning stage.

- (ILO1) Explain how materials and information management technologies are structured and how they can help optimise production logistics.
- (ILO2) Apply methods and calculation methods for controlling production, inventory, and order logistics, including forecasts, order point security inventory, and order quantity.

3.2 Course on logistics & operations at Wiesbaden Business School

At the Wiesbaden Business School (WBS), the game will be used in a 5 ECTS course from an elective module on supply chain and operations to 4/5th semester undergrad students from both the business administration and the international management programs. The module is currently redesigned for reaccreditation and will cover 6 ECTS and host students from the digital business management program in the future. The relevant ILOs from the future course are equal or close to the current ILOs.

- (ILO3) Analyze business processes using respective tools such as activity-based costing / process cost accounting and benchmarking and identify improvement potentials in operations.
- (ILO4) Review for digital and/or process solutions to improve process efficiency.
- (ILO5) Make decisions on process improvement measures, apply solutions, and critically evaluate the results.

3.3 Heriot-Watt University engineering and manufacturing course

At Heriot-Watt production and operations management is covered under the engineering and manufacturing course. This semester two course has the equivalent of 7.5 ECTS and is mandatory for all final year mechanical engineering students. The primary ILOs are:

- (ILO6) Capacity resource planning and materials requirements planning. Apply methods and calculation methods for controlling production, inventory, and order logistics, including forecasts, order point security inventory, and order quantity

- (ILO7) Another related LO is how factory layout affects shop-floor logistics and production.
- (ILO8) Digital manufacturing. This applies to digitalisation of shopfloor logistics and production workflow automation.

3.4 Intended Learning Outcomes and Production Line

After having collected the ILOs and identified common ground between the courses, it is necessary to understand which of the ILOs are in line with the functionalities of Production Line. Although each course has some unique directions resulting from their respective study programs' contexts, some commonalities related to production logistics and operations management were identified. The ILOs on process management and controlling are reflected in all three courses (see ILO2 at KTH, ILO 6 at Heriot-Watt, and ILO3 and partly ILO5 at WBS). In addition, the courses aim to teach students on technologies used to improve processes and operations management (ILO1 at KTH; ILO4 and ILO5 at WBS; ILO8 at Heriot-Watt).

4 Discussion of Game Adoption

In reviewing whether the game could be used to meet the different ILOs, the authors experimented with the game set-up while discussing in more detail how the game can best be integrated in a learning environment and what needs to be considered by a facilitator's as well as from a teacher's point of view (see Fig. 1). This includes considerations related to the introduction of the game and explaining its functionalities, and tasks the students are supposed to perform prior to, during and after gameplay. Hence the analysis is evocative of some general considerations that are relevant when applying a COTS game.

As previously mentioned, Production Line is a COTS single player game. The manual and tutorial are built in the game play, which often give a more immersive experience. However, used in a learning context, it is important that both learning objectives and gameplay are understood. The easiest way of ensuring this, is to add a briefing phase in which the facilitator explains the game elements, the objective of both the game and the expected learning. This will also allow an experienced facilitator to adapt the game play to the right level for the students and to suggest variations in the game play in case the game is played several times or with the objective to trigger and investigate a specific problem.

A limitation the authors have seen in their own play experience is the need of proper instruction to achieve a common base for all players, e.g., on the type of factory size and scenario to be played as well as a detailed overview of all possible variables. The authors consider starting with a small factory and a pre-defined scenario rather than a sandbox (e.g., with unlimited resources) to have goals the students would need to work towards. This also allows adding a competitive element outside the game in the classroom comparing players or teams of players in a high score.

In the current analysis of possible ways of using the game in the different courses, we have identified several possibilities to use the same game scenario to address different challenges and different learning goals. These findings and reviewing the ILOs discussed here may also help other teachers to evaluate whether Production Line may be appropriate for their syllabus. However, so far only the authors have played the game in such a setting. To evaluate the ease of use as well as the immersiveness among students, we need to test the game with the target group to see whether the game can be played in the given timeframe with the expected learning outcomes per student. Applying the game in different study programs will allow the authors to better understand differences due to students' backgrounds and skills. This can support the authors to optimize the delivery of a good learning experience.

5 Conclusion and Next Steps

According to our analysis, the COTS game Production Line seems to fulfil our requirements to be implemented and used in different ways in the envisaged courses.

Regarding the flexibility of the gameplay, we see that the game has the potential for being used to:

- Explore shop floor design and factory layout and investigate the impact on the production capacity and throughput time
- Experience resource management
- Investigate the role of technology development and research (qualification)
- Apply different strategies on the operational level, depending on pre-defined criteria as goals.

In the next step, the author will develop the supporting material and define test-scenarios that can be used to evaluate how well the game supports the learning process. It is our intention to implement the game in the upcoming academic year. Based on the evaluation results and students' feedback the authors will adapt both supportive material and, if required, the description on how to develop the sandbox game.

References

1. Pourabdollahian Tehran B, Oliveira MF, Taisch M et al. (2013) Status and trends of serious game application in engineering and manufacturing education. In: International simulation and gaming association conference, pp 77–84
2. Heiko Duin, Jannicke Baalsrud Hauge, Felix Hunecker et al. Application of Serious Games in Industrial Contexts. In: Business, Technological, and Social Dimensions of Computer Games: Multidisciplinary Developments. IGI Global, pp 331–347
3. Wood L, Reiners T (2012) Gamification in logistics and supply chain education: Extending active learning. *Internet Technologies & Society* 2012:101–108

4. Supply Chain Process Improvement, Inc. SCOR Metrics. <https://scpiteam.com/SCOR%20Metrics.htm?msclkid=5fcc50abc86b11ec8eeaab90d845cbeb>. Accessed 30 Apr 2022
5. Dissanayake CK, Cross JA (2018) Systematic mechanism for identifying the relative impact of supply chain performance areas on the overall supply chain performance using SCOR model and SEM. *International Journal of Production Economics* 201:102–115. <https://doi.org/10.1016/j.ijpe.2018.04.027>
6. Despeisse M (2018) GAMES AND SIMULATIONS IN INDUSTRIAL ENGINEERING EDUCATION: A REVIEW OF THE COGNITIVE AND AFFECTIVE LEARNING OUTCOMES. In: 2018 Winter Simulation Conference (WSC). IEEE, pp 4046–4057
7. Woschank M, Pacher C (2020) A Holistic Didactical Approach for Industrial Logistics Engineering Education in the LOGILAB at the Montanuniversitaet Leoben. *Procedia Manufacturing* 51:1814–1818. <https://doi.org/10.1016/j.promfg.2020.10.252>
8. Ştefan IA, Hauge JB, Hasse F et al. (2019) Using Serious Games and Simulations for Teaching Co-Operative Decision-making. *Procedia Computer Science* 162:745–753. <https://doi.org/10.1016/j.procs.2019.12.046>
9. Karl CK, Lokosch H (2020) Increasing decision making competencies by applying simulation and gaming in technology and engineering education. In: Vries M de, Fletcher S, Kruse S et al. (eds) *The impact of technology education: International insights*. Waxmann, Münster, New York, p 63
10. Baalsrud Hauge J, Stefan IA, Sallinen N et al. (2021) Accessibility Considerations in the Design of Serious Games for Production and Logistics. In: Dolgui A, Bernard A, Lemoine D et al. (eds) *ADVANCES IN PRODUCTION MANAGEMENT SYSTEMS. ARTIFICIAL INTELLIGENCE FOR*, vol 633. SPRINGER, [S.l.], pp 510–519
11. Hauge JMB, Pourabdollahian B, Riedel, Johann C. K. H. (2013) The Use of Serious Games in the Education of Engineers. In: Springer, Berlin, Heidelberg, pp 622–629
12. Riedel, Johann C. K. H., Baalsrud Hauge J (2011) State of the art of serious games for business and industry. In: 2011 17th International Conference on Concurrent Enterprising, pp 1–8
13. Arnold U, Söbke H, Reichelt M (2019) SimCity in Infrastructure Management Education. *Education Sciences* 9:209. <https://doi.org/10.3390/educsci9030209>
14. Inchainge B.V. Discover The Fresh Connection. <https://inchainge.com/business-games/tfc/>. Accessed 30 Apr 2022
15. Inchainge B.V. Discover The Blue Connection: From Linear to Circular. <https://inchainge.com/business-games/tbc/>. Accessed 30 Apr 2022
16. Baalsrud Hauge J, Kalverkamp M, Bellotti F et al. (2014) Requirements on learning analytics for facilitated and non facilitated games. In: 2014 IEEE Global Engineering Education Conference (EDUCON). IEEE, pp 1126–1132
17. KTH ML1504 Produktionslogistik: 6,0 hp. Logistics in Production. <https://www.kth.se/student/kurser/kursplan/ML1504-20192.pdf?lang=sv>. Accessed 30 Apr 2022