Received: 14 March 2023 | Accepted: 16 March 2024

DOI: 10.1111/dsji.12315

DECISION SCIENCES
JOURNAL OF INNOVATIVE EDUCATION

TEACHING BRIEF

Teaching information flow in supply chains: A role-playing game using *TagScan*

Xiaojia Wang | **Rickard Enstroem**

Department of Decision Sciences, School of Business, MacEwan University, Edmonton, Canada

Correspondence
Rickard Enstroem, Department of Decision Sciences, School of Business, MacEwan University, 10700-104 AVE NW, Edmonton AB T5J 4S2, Canada.
Email: EnstroemR@macewan.ca

Abstract

Information flow is one of the three main flows of supply chains. It is an abstract concept that can be challenging for students to grasp in its entirety. This article describes a role-playing game for teaching the topic of information flow in an undergraduate supply chain management course. The game allows students to simulate receiving and fulfilling customer orders by playing five roles within a manufacturing company. Students use *TagScan*, an augmented reality barcoding and logistics system launched by a technology company in western Canada, to track information throughout the game. Pre- and postsurvey results demonstrate the effectiveness of the proposed game in helping students visualize abstract course concepts and understand the types of information being tracked, the available information transmission technology, and the dynamics of information flow in a supply chain. Students were actively engaged in this in-class activity and responded positively to the learning-by-gaming experience.

KEYWORDS

augmented reality, barcoding, information flow, role-playing game, supply chain

1 | INTRODUCTION

Supply chains feature three main flows: product flow, information flow, and financial flow (Novack et al., 2019). Understanding and modeling information flow within an organization is itself challenging (Durugbo et al., 2013). These challenges are compounded in the context of supply chain networks, characterized by extensive information exchanges within and among many entities and stakeholders. Furthermore, the industry is currently undergoing a transformation from a linear information flow model to an integrated model where information flows in multiple directions—Supply Chain 4.0 (Ferrantino & Koten, 2019).

Unlike physical products and financial transactions, supply chain information flow is not directly visible, which may make it harder for students to understand. Additionally, while students might grasp parts of the information flow, there is an ongoing concern that business students and professionals often lack systemic thinking (Atwater et al., 2008; Webb et al., 2014). The implication is that students struggle with understanding the role and purpose of a system and its parts—synthetic thinking—understanding how the system and its parts behave over time—dynamic thinking—and understanding how the parts of the system react and interact with each other—closed-loop thinking (Atwater et al., 2008).

Information flow in supply chains refers to the exchange and transmission of data and knowledge among the various entities in the supply chain, such as suppliers, manufacturers, distributors, retailers, customers, and any extended supply chain members. Effective information flow is crucial for supply chains because it forms the basis of supply chain visibility (Mor et al., 2018), collaboration (Cao & Zhang, 2011), and agility (Brusset, 2016), all essential facets in today's large-scale data era. On the other hand, real-time information flow has always been challenging because of the heterogeneity of platforms and technologies used by the different parties in the supply chain (Gnimpieba et al., 2015).

Information flow can involve various types of information such as demand forecasts, production schedules, inventory levels, shipment status, and customer feedback. These types

of information can be shared through different communication channels; traditional means range from phone calls, faxes, and emails to integrated platforms such as electronic data interchange (EDI) and enterprise resource planning (ERP) systems. However, new technologies and platforms, including blockchain, the Internet of Things (IoT), digital twins, and cloud-based systems, further advance information flow in supply chains.

Without relevant work experience, students can hardly imagine the dynamics of information flow among the supply chain's different entities. For example, teaching students that "Timely, two-way flows of accurate information help mitigate the bullwhip effects" may elicit mere assent. When discussing documents and online platforms that pass information throughout a supply chain, students will likely think about them in a static and isolated way. To address this challenge, this teaching brief documents a role-playing game for teaching the concept of information flow in an undergraduate supply chain management course. In the proposed game students play different roles inside a manufacturing company and use *TagScan*, an augmented reality barcoding and logistics system launched by a rising technology company in western Canada, to understand the information flow in supply chains better.

The four learning objectives of the role-playing game are for students to understand (i) information flows within supply chains, (ii) types of information tracked in supply chains, (iii) information flow dynamics in supply chains, and (iv) available technologies for information flow in supply chains.

2 | LITERATURE

2.1 | Teaching through role-playing games

Active learning and simulation-based pedagogy have gained significant attention in supply chain management classrooms to illustrate academic concepts (Angolia & Pagliari, 2018). Role-playing games, which fall under the broader category of simulation games (Paul & Ponnam, 2018), offer learners a safe environment to actively engage in interpersonal activities (Feinstein et al., 2002). Several studies, including Martocchio and Webster (1992), Quinn (1996), and Li et al. (2017), have demonstrated that incorporating applied gaming tools in teaching can enhance knowledge retention and serve as effective pedagogical aids to supplement conventional classroom instruction. By immersing students in interactive learning experiences, role-playing games facilitate a deeper understanding of abstract concepts (Porter, 2008) and enable students to observe the direct impact of their actions on the supply chain in a cost-effective and timely manner (Shaltayev, 2021). Further, Enstroem and Schmaltz (2024) underscore the role of experiential learning in large-scale teaching environments, advocating strategies that not only engage students in practical, real-world scenarios but also foster the development of crucial transversal skills, thereby aligning educational outcomes with industry needs and enhancing students' work readiness.

According to Wood's (2007) classification of simulation games, the proposed role-playing game belongs to the category of insight games. These games are designed to provide a context that enables students to quickly grasp key ideas related to a specific topic, often resulting in "Aha" moments. Furthermore, based on Grandzol and Grandzol's (2018) classification focusing on implementation methods, the proposed role-playing game can be categorized as both an application software-based and a tangible product-based simulation game. While application software-based games have decreased in popularity due to installation complexities (Shaltayev, 2021), the proposed role-playing game utilizes a mobile app already adopted in real-world business settings. With its user-friendly design and streamlined download process, the app minimizes preparation work and ensures a seamless user experience.

2.2 | Related technology

Automated techniques for identifying and capturing data, Automatic Identification and Data Capture (AIDC), offer efficient and precise data collection methods (Vazquez-Briseno et al., 2012). The captured data can then be stored or analyzed by a computer or another device. Examples of AIDC technologies include barcodes, QR codes, and RFID (i.e., Radio Frequency Identification). QR code stands for Quick Response code, a two-dimensional barcode, while RFID uses radio waves to communicate between an RFID reader and an RFID tag attached to an object. As a result, the fundamental mechanisms for barcodes and RFID to work are different. Nowadays, one of the applications of those AIDC technologies is to track objects in real-time and collect information for supply chain management purposes. Users need specifically designed devices to read the corresponding tags, including barcode scanners, magnetic stripe reading, or smartphones that can scan barcodes directly.

Comparing barcodes/QR codes with RFID, RFID is much faster, especially when multiple tags need to be read simultaneously (Wamba & Boeck, 2008). Moreover, RFID tags can be read from a longer distance and generally store more relevant data such as serial number, location, lot number, and status (Wyld, 2006). However, implementing and maintaining an RFID system is much more costly (Rahaman, 2016). Ultimately, the choice among different AIDC technologies will depend on the specific application and the type and scale of information that needs to be tracked or communicated.

The proposed role-playing game adopts a novel AIDC technology named *TagScan*, a recently developed tracking and information transmission technology that can be applied in the supply chain industry. The *TagScan* system is a barcoding and logistics system that utilizes augmented reality. It consists of a fiducial marker system and a cloud-based database. *TagScan* is a cost-effective Software as a Service (SaaS) system that helps manage and track production and

TABLE 1 Comparison of TagScan with Barcode/QR Code and RFID.

	Barcode/QR code	RFID	*TagScan*
Scan distance	Short	Medium	Long
Processing speed	Slow	Fast	Fast
Information amount stored	Small	Large	Large
Cost	Low	High	Low
Simultaneous scans	No	Yes	Yes
Line of sight	Yes	No	Yes

workflow across various stages such as factories, warehouses, delivery, and deployment (ProductionAR, n.d.). The benefits of *TagScan* include fast and far-reaching scanning capabilities and a practical and affordable option for creating personalized markers and attaching them to specific items. Users can use a dedicated app on their mobile devices to scan several markers at once, even while on the move. Once scanned, the cloud database is immediately updated with several pieces of information. *TagScan* incorporates some of the benefits of barcodes/QR codes and RFID, making it a groundbreaking AIDC technology that can enhance information flows within supply chains. Table 1 compares *TagScan* with Barcode/QR Code and RFID (Fiala, 2009; Tripathi & Dwivedi, 2021).

3 | ROLE-PLAYING GAME

3.1 | About the game

The role-playing game is incorporated into an introductory-level supply chain management class. Before the game session, the instructor delivers a lecture on the significance of accurate and timely information flow in supply chains. The lecture introduces sample documents for information flow (e.g., purchase order and inventory status) and information necessary for a shipment (e.g., weight, type of packaging, and carrier information). During the game session, the instructor briefly discusses standard scanning technologies, including barcodes, QR codes, and RFID. The instructor then demonstrates how the *TagScan* system works to collect information and manage data in its cloud database. Lastly, the instructor introduces the game rules. Appendix A provides sample game instruction slides an instructor can use when introducing different game roles to students.

The purpose of the role-playing game is to involve students in a simulated scenario where a manufacturing company's supply chain members must record and manage information from receiving a customer order to delivering the order to its destination. The game procedure focuses on the internal supply chain structure. However, by modifying the stations to represent Supplier, Distributor, Manufacturer, Wholesaler, and Retailer, its design can be adapted to simulate external supply chain information flows. The intended learning outcomes will be the same regardless of whether an internal or external supply chain structure is employed, and the game setup and procedure changes are minimal. By going through all stages in the information flow process to fulfill an order, students transform theoretical ideas of information flow into practical, hands-on experiences. For the game to be a meaningful learning experience for students, we suggest introducing the game after students have received an overview and understood the basic terminology, the involved stakeholders, the overall functioning of the supply chain as a system, and the inherent customer focus. In a typical undergraduate supply chain management course, the game fits well after students have been introduced to the Sales & Operations Planning of the supply chain.

3.2 | Materials needed

Before the game starts, the instructor needs to prepare the following items. Figure 1 shows the classroom setting before the role-playing game.

1. Five printed location signs. They are put on five desks in the classroom, representing five different workstations: Sales Office, Warehouse, Assembly Center, Shipping Department, and Destination. Supplement A in the supporting file provides a set of printable location signs for game implementation.
2. A pile of engineering drawings put at the Sales Office workstation, representing customer orders (Picture 1 in Figure 1). Supplement B provides 10 printable engineering drawings. With more than ten student groups, an instructor can print multiple copies of one or more engineering drawings. It does not affect the game implementation.
3. A batch of customized *TagScan* markers (Picture 1 in Figure 1) to be pasted onto the engineering drawings so the *TagScan* system can scan the marker and record unique information about each order. Supplement C provides a sample batch of ten printable *TagScan* markers for game implementation. The sample markers correspond to a database structure, (i.e., types of columns), shown in Figure 2. The *TagScan* system offers customization features to different customers, such as recording other types of information with a corresponding database structure. Customized markers can be provided by contacting ProductionAR through sales@productionAR.com.
4. A box of colored blocks representing parts and components used to assemble finished products to fulfill customer orders (Picture 2 in Figure 1). For game implementations, instructors can use similar colored blocks or generic LEGO blocks available at toy stores.
5. At least five mobile devices (smartphones or tablet products) equipped with the *TagScan* mobile app for scanning the markers at the five workstations and one computer for logging in to the web console and monitoring the cloud database during the game. Appendix B provides a *TagScan* app installation and login user manual.

FIGURE 1 Classroom setting before the role-playing game.

(1) On the five mobile devices, an instructor or student can manually type in the username and password in Step 02 of Appendix B to log in to a demo account for classroom use.
(2) On the computer, an instructor can access the cloud database for the demo account by going to the website of ProductionAR (https://www.productionar.com/), clicking on the "Login" button in the upper right corner, and logging in with the same username and password in Step 02 of Appendix B. Although the web console works on both mobile devices and computers, it is best if the instructor uses a computer to manage it and show the cloud database on a classroom screen. This way, the students can see live updates on the big screen while engaging with the game using mobile devices.

Before the game, each mobile device is set to the appropriate mode corresponding to the workstation's role. The *TagScan* system allows users to create different Scan Mode Roles based on their business needs. For example, in the proposed game, students could choose from eight Scan Modes: create/edit customer names, add descriptions, record parts being pulled from the warehouse, add quarantine notes (i.e., for abnormal situations), record assembly completed, record product being shipped, add multimedia notes, and record products received on site (i.e., at destination). Appendix C provides information on the matching relationship between each workstation and its designated scan mode. Three standard scan modes can be used for all workstations.

3.3 | Game play

In the proposed game, students form groups assuming roles as Sales Office, Warehouse, Assembly Center, Shipping Department, and Destination. Ideally, each group will have five members playing one of the five roles. If there are fewer than five students per group due to class size, some students will take on multiple roles. Throughout this article, we will refer to students by their game roles, such as "Sales Office" for the student in that role and similarly for the other four roles.

Appendix D provides a quick guide for game play using the *TagScan* system. For more comprehensive instructions accompanied by screenshots, please refer to Supplement D. We recommend that students install the *TagScan* app and familiarize themselves with its functionalities at least a week before its required use in-class exercises. This preparatory step is crucial for acclimating students to the app, thereby minimizing disruptions to the learning process.

3.3.1 | Sales office

The Sales Office receives, checks, and confirms customer orders. To start the game, the Sales Office picks an engineering drawing representing a customer order for a product to be produced. The Sales Office attaches a *TagScan* marker to the engineering drawing and scans it with the *TagScan* mobile app in New Job Mode to generate order information. Step 1 in Appendix D and Supplement D outlines how to create a new order record with a marker from Supplement C. The MARKER ID, start date, and time in the cloud database are generated when scanning the marker.

MarkerID	StartDate	CustomerName	Description	Parts pulled from warehouse	Quarantine Notes	Assembly Complete	Shipped	Multimedia Notes	Received on Site	Completion Status	Elapsed Time	Status
214220	2023-01-13 13:35	Sunny & Mark Global Corp		2023-01-13 13:36		2023-01-13 13:37	2023-01-13 13:38	...		complete	54 days	Received on Site
214223	2023-01-13 13:43	Smarties		2023-01-13 13:44		2023-01-13 13:44	2023-01-13 13:45	...		complete	54 days	Received on Site
214226	2023-01-13 13:44	A Team		2023-01-13 13:44		2023-01-13 13:45	2023-01-13 13:46	...		complete	54 days	Received on Site
214229	2023-01-13 13:45	Banada Manufacturing		2023-01-13 13:45	Missing part yeah	2023-01-13 13:48	2023-01-13 13:48	...		warning	54 days	Received on Site
214232	2023-01-13 13:45	Five Guys		2023-01-13 13:46		2023-01-13 13:46	2023-01-13 13:46	...		complete	54 days	Received on Site
214235	2023-01-13 13:46	Team B			Missing part yeah	2023-01-13 13:48	2023-01-13 13:48	...		warning	54 days	Received on Site
214238	2023-01-13 13:46	Template Name		2023-01-13 13:47		2023-01-13 13:48	2023-01-13 13:48	...		complete	54 days	Received on Site

Add New Job (row)

Row type (optional) none

Add job with Marker ID# 000000

Add job without Marker ID#

Table Data

Download to CSV file

Download Filtered to CSV file

Download Visible to CSV file

FIGURE 2 Game records.

Meanwhile, the Sales Office creates a company name representing the team responsible for this order and records any special customer requirements as descriptions. The four types of information are shown in the first four columns in Figure 1. The Sales Office then sends the confirmed drawing to the Warehouse, the first of the four order fulfillment departments.

3.3.2 | Warehouse

The Warehouse selects colored blocks as parts for the product based on the drawing and scans the *TagScan* marker in "Parts pulled from warehouse" mode to log the date and time parts are taken (see Column 5 in Figure 2). Step 2 in Appendix D and Supplement D shows the app's scanning procedure. The Warehouse then sends the colored blocks with the drawing to the Assembly Center.

Users can switch to Quarantine Notes in each scan mode to log abnormalities. When the game was played in the instructor's class, two groups encountered issues of missing parts. They are listed in Column 6 in Figure 2.

3.3.3 | Assembly center

The Assembly Center assembles the product using the selected colored blocks according to the drawing. The *TagScan* marker is scanned in its designated mode, "Assembly Complete," to record the date and time when the assembly is completed (Column 7 in Figure 2). Step 3 in Appendix D and Supplement D shows the app's scanning procedure. The Assembly Center sends the finished assembled product and the drawing to the Shipping Department.

3.3.4 | Shipping department

The Shipping Department moves the finished product to another location, simulating the packaging and vehicle

dispatching process. The Shipping Department scans the *TagScan* marker in "Shipped" mode to log the shipping date and time (see Column 8 in Figure 2) and sends the product and drawing to the Destination (Customer). Step 4 in Appendix D and Supplement D shows the app's scanning procedure.

3.3.5 | Destination

When the final workstation receives the product, it marks a successful delivery. After inspection, the Destination scans the *TagScan* marker in "Received on Site" mode, generating information to document order completion. First, the destination's location is linked to Google Maps. Completion status is labeled as "complete" for fulfilled orders or "warning" for those with quarantine notes. "Elapsed time" displays the duration since the last update, and a final "Received on site" is recorded. This information appears in the last four columns of Figure 2. Step 5 in Appendix D and Supplement D shows the app's scanning procedure.

Users can attach a photo or video as a multimedia note (Column 9 in Figure 2) each time they scan the marker. This feature can prove helpful when photographing a product before shipping to verify its condition. Students should understand that different information types can have different functions in optimizing the supply chain's information flow.

Information moving through the company's internal logistics chain is instantly saved to the cloud database once the marker is scanned. Authorized parties can access real-time production updates and spot workflow irregularities. A web console displays the database, allowing students to see the recorded information, how time stamps are created instantly, changes in work status, and the dynamics of information flow.

4 | STUDENTS' FEEDBACK

To evaluate the game's effectiveness, the authors created two surveys to gather feedback from students in the introductory supply chain class. Before the game session, students completed a 10-question survey to measure their initial understanding of supply chain information flows. After the game, they completed a 14-question survey to evaluate their knowledge in the same area and provide game feedback.

The first ten questions of both surveys are the same. Questions 1–5 collect demographic information such as age, gender, year of study, and major/minor. Questions 6–10 are five Likert-scale statements about students' understanding of supply chain information flow. The authors adopted the survey questions from Yang and Guo (2020) and customized them for this project. The postsession survey includes four new questions: Questions 11–13 are Likert-scale statements on the game experience, and Question 14 is an open-ended question for feedback on the guest lecture. As the two surveys have the first 10 questions in common, the postsession survey is provided in Appendix E.

TABLE 2 Two-tailed *t*-test results.

Mean scores	Q6	Q7	Q8	Q9	Q10
Presession	4.34	5.31	5.38	4.76	4.66
Postsession	2.54	6.25	6.29	6.04	5.86
Difference	–1.81***	0.94***	0.91***	0.28***	1.20***

***$p < 0.01$.

In a class of 38 students, 29 participated in the game, and 5 were females. Most were senior undergraduates (Year 3 or 4) in the Bachelor of Commerce (BCom) program, aged between 20 and 24, suggesting some may have had supply chain internships or work experience. Notably, 27 students were majoring or minoring in supply chain management, indicating that their prior coursework and interest provided a solid knowledge base. Training from other supply chain courses in their junior years likely equipped them with a basic supply chain knowledge foundation. The complete student demographic information is shown in Figure 3.

The presession results in Figure 4 show that nearly half of the students found the concept of information flow abstract for Question 6. In Questions 7 to 10, most students felt they understood information flow and the trackable information types in a supply chain. However, many were less familiar with the technologies and dynamics of information flow.

The postsession survey results demonstrate the game's effectiveness even for senior supply chain students with some supply chain-related work experience, as shown in Figure 5. The results for Question 6 show that most students no longer found the concept of information flow abstract, indicating that engaging them in a simulated process effectively helped them visualize the concept. The responses to Questions 7–10 consistently shifted toward the Agree/Strongly Agree direction after the game, demonstrating that the role-playing game was successful in improving students' understanding of (i) information flows within supply chains, (ii) types of information tracked in supply chains, (iii) information flow dynamics in supply chains, and (iv) available technologies for information flow in supply chains.

A two-tailed *t*-test compared presession and postsession mean scores for Questions 6–10, with responses numerically coded from "Strongly Agree" (7) to "Strongly Disagree" (1). The statistical findings in Table 2 show significant improvements in students' understanding of information flow aspects.

The four new questions in the postsession survey showed that students enjoyed the role-playing game, with nearly all 29 participants liking the *TagScan* tracking technology. Everyone learned something new and felt engaged during the session. Question 14 asked for game feedback. Eight students wished for more playtime than the 50-min class allowed, while five provided positive feedback on the session, especially using the *TagScan* technology. A representative selection of students' verbatim statements is provided below:

- "I thought it was a cool concept and gives me an idea of how the industry is changing for the better."

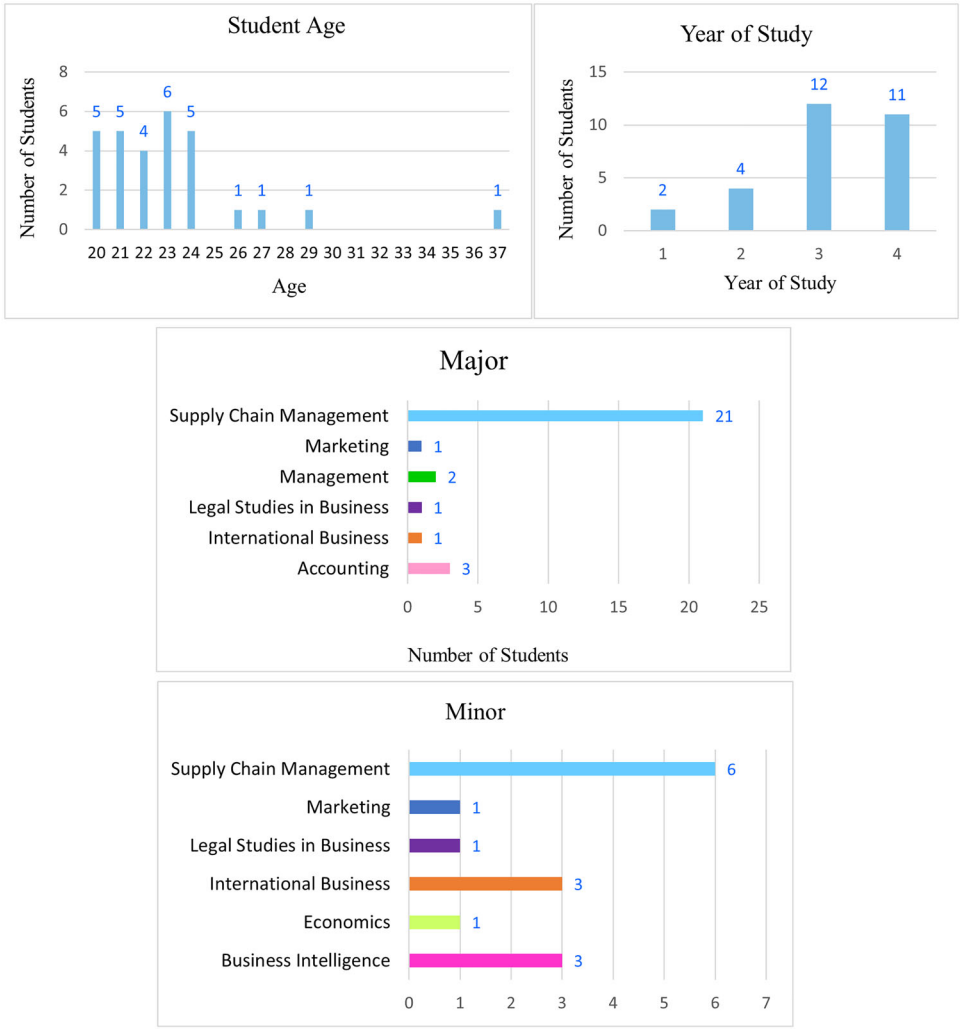


FIGURE 3 Demographic information of 29 participants (24 males and 5 females).

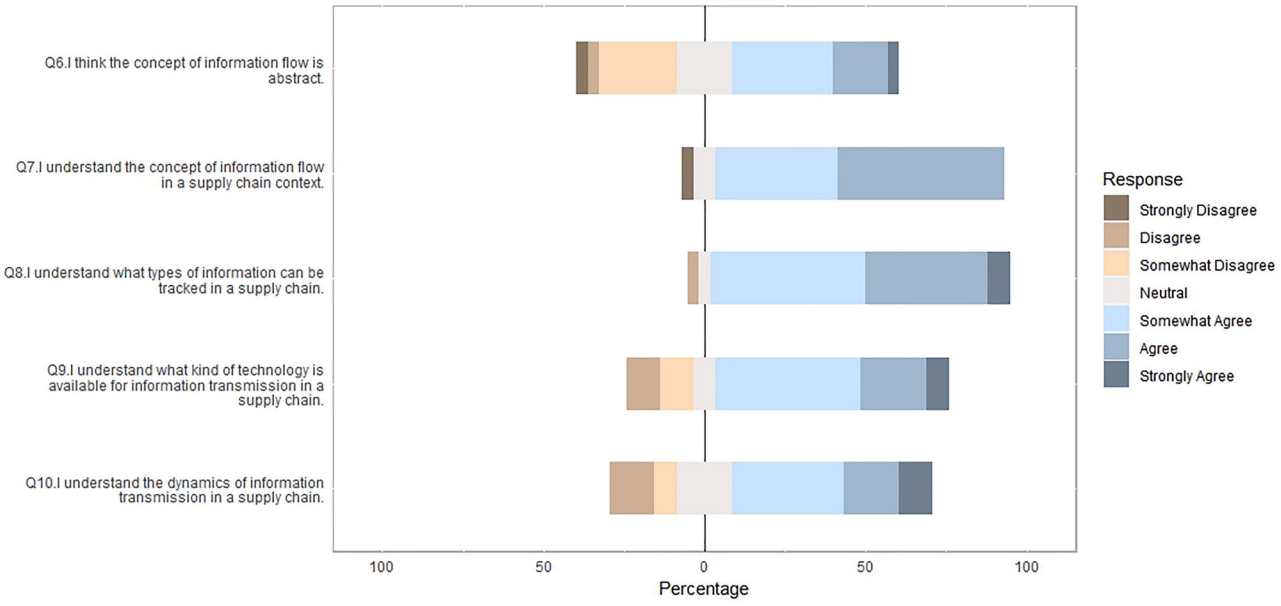


FIGURE 4 Presession survey results.

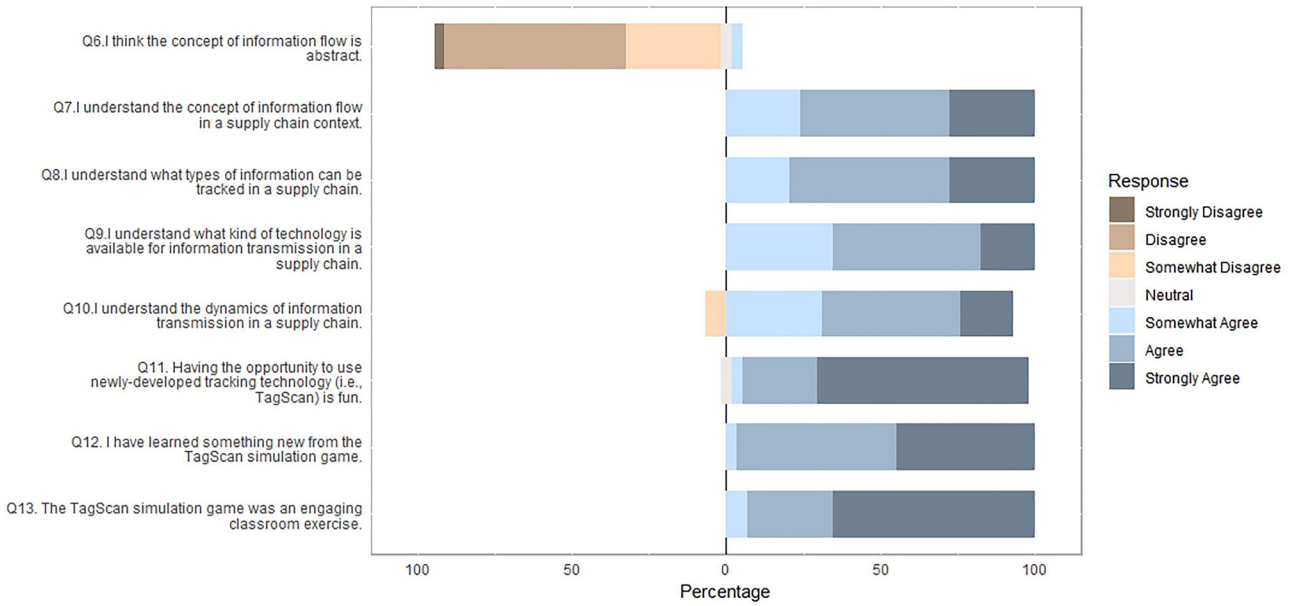


FIGURE 5 Postsession survey results.

- "It was a really cool demonstration and technology. I'll be looking out for *TagScan* in the future."
- "It was fun!"
- "The presentation and game were really interesting & work is very innovative!"
- "Was a lot of fun."
- "Wish we had more time to explore!"
- "I wish we had more time to interact with new technology, but otherwise it was fun and informative."

5 | DISCUSSION

This paper presented an interactive role-playing game to teach information flow in an undergraduate supply chain management class. The game features a simple setup with minimum equipment and preparation needed. It is designed to give students a holistic understanding of information flow in a supply chain in a systemic way: understanding how the different parts of the information flow interact and make up the whole system, the behavior of the system and its parts over time, and how the details of the information flow react and interact with each other. A bonus is that students get exposure to— and appreciation of—technology's role in facilitating information flow within supply chains.

The presented game teaches students about the information flow of the internal supply chain. However, the design can easily be altered to demonstrate the external supply chain's information flow by changing the stations to Supplier, Distributor, Manufacturer, Wholesaler, and Retailer. While the game is specifically designed to teach information flow, other aspects of the supply chain can be brought in in subsequent game rounds. For instance, if used to demonstrate an external supply chain, price markups at each stakeholder in the game can give students a thorough systemic understanding of the information flow in conjunction with the financial flow among the external supply chain parties.

With its current design, the game has successfully run several semesters in the BCom program, and the survey results show that the game assists students in solidifying their knowledge of information flows. Once students understand the information flow fundamentals well, the game can quickly be adopted and gamified in subsequent rounds. Suggested outcome assessments are (I) Speed of Completion, (II) Completeness of Information Recording, and (III) Number of Critical Incidents. As game records can be downloaded to a CSV file from the web console (Figure 2), students can easily measure their game performance. For example, students can use time stamps from two workstations to measure completion speed at the second station and count critical incidents by checking the Completion Status column. They can also analyze critical accident details through Quarantine Notes. These measures closely mirror current supply chain performance metrics of on-time delivery, order cycle time, lead time, perfect order fulfillment, and responsiveness.

If students run repeated rounds of the game, we recommend using a structured approach modeled on Kolb's Experiential Learning Cycle (Kolb, 2014), as suggested in Enstroem and Schmaltz (2023). Students would then run successive rounds of the game while being instructed to approach their learning from an experiment-experience-reflect-conceptualize perspective. After each game, which could be part of an assignment, students would be asked to reflect on their experiences and apply their newfound insights in the next round of the game, which could happen a week later. This approach can complement the gamified supply chain outcomes by assessing students' personal growth and upward learning trajectory, as contained in their reflections.

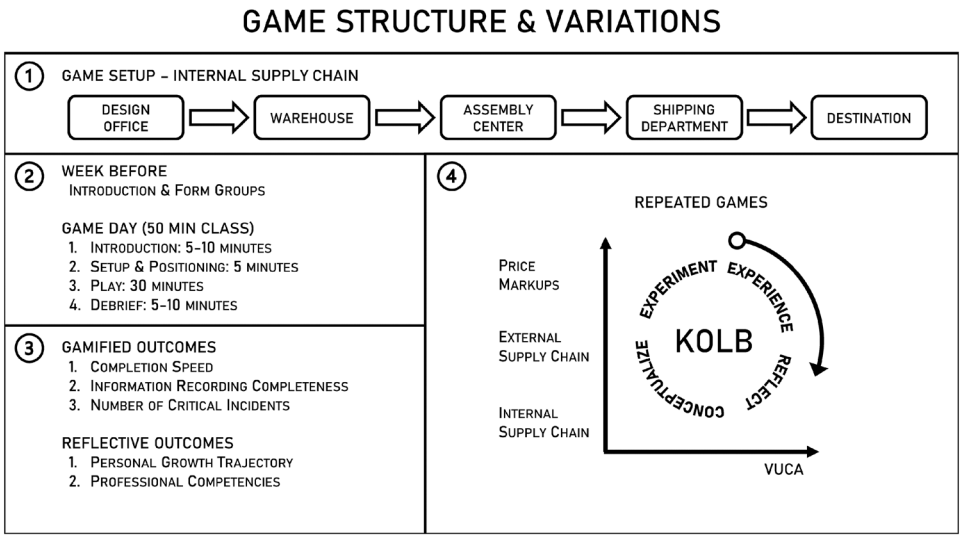


FIGURE 6 Game structure and variations.

The benefit is that the assessment then integrates both subject matter outcomes and the development of professional competencies, such as teamwork, presentation, writing, ethics, and critical thinking (Benson & Enstroem, 2017).

With an iterative approach to the game, the instructor can gradually increase the difficulty by starting with the basic information flow for the internal supply chain, then bringing it into the realm of the external supply chain, and then introducing price markups. Another option is to integrate Kolb's Experiential Learning Cycle with the Volatile-Uncertain-Complex-Ambiguous (VUCA) framework, as Enstroem and Schmaltz (2023) recommend. Subsequent game rounds would then gradually introduce uncertainty and complexity. Increasing VUCA can, for instance, be achieved via imperfect demand information, sudden supplier breakdown, and product line expansions.

Integrating industry-standard technical interfaces like *TagScan* into classroom settings introduces challenges, including technical difficulties and user errors. However, we view these challenges not as setbacks but as integral to the learning experience. This approach mirrors work-integrated learning (Enstroem & Benson, 2024), preparing students for the workplace's complex and uncertain realities by fostering resilience (Enstroem & Schmaltz, 2023).

Having embraced the educational value of integrating real-world technical interfaces, we now turn to how these principles are applied within the constraints of a typical 50-min class session. We recommend forming the teams and familiarizing students with the setup, purpose, and learning outcomes of the game the week before the game is to take place. The instructor would then use 5–10 min at the beginning of the class to remind students about the context and purpose of the game and 5 min to set up the game and position the teams. The game would then go on for approximately 30 min, followed by a 5- to 10-min debrief discussion, where the instructor can present the results and students can share their experiences of the game, what they learned, and what they would do differently next time they play it. For longer classes, there can be a richer contextualization at the beginning of the class, a break for mid-game class reflection, and a longer postgame debrief. We ran the game for a class size of 25–40 students, with five to eight groups of five students each. For bigger class sizes, students can be divided into two sessions. Figure 6 provides a summary of the game structure and variations of the game.

6 | CONCLUSION

This article presents a role-playing game designed for an undergraduate supply chain management course to teach the topic of information flow. The proposed game involves students playing five roles within a manufacturing company to simulate receiving and fulfilling customer orders. Students use *TagScan*, an augmented reality barcoding and logistics system developed by a technology company in western Canada, to record and track information throughout the game. The pre- and postsurvey results show that the game effectively strengthens students' understanding of the information tracked in a supply chain, the dynamics of information flow in a supply chain, and the types of technology available for sharing information in a supply chain. The game successfully meets the four learning objectives set before the session. It helps students visualize a challenging course concept while introducing the latest technological developments in the supply chain industry. Based on the experiences in this study, incorporating a similar learning-by-gaming approach in teaching theoretical concepts would benefit future educators and students.

ACKNOWLEDGMENTS

The authors are indebted to Dr. Mark Fiala, ProductionAR.com.

ORCID

Rickard Enstroem https://orcid.org/0000-0002-1895-7586

REFERENCES

Angolia, M.G. & Pagliari, L.R. (2018) Experiential learning for logistic and supply chain management using an SAP ERP software simulation. *Decision Sciences Journal of Innovative Education*, 16(2), 104–125. https://doi.org/10.1111/dsji.12146

Atwater, J.B., Kannan, V.R. & Stephens, A.A. (2008) Cultivating systemic thinking in the next generation of business leaders. *Academy of Management Learning & Education*, 7(1), 9–25. https://doi.org/10.5465/amle.2008.31413859

Benson, L. & Enstroem, R. (2017) Deliberate institutional differentiation through graduate attributes: Implementing professional skills at MacEwan School of Business. *Journal of Management Development*, 36(6), 817–827. https://doi.org/10.1108/JMD-08-2016-0148

Brusset, X. (2016) Does supply chain visibility enhance agility? *International Journal of Production Economics*, 171, 46–59. https://doi.org/10.1016/j.ijpe.2015.10.005

Cao, M. & Zhang, Q. (2011) Supply chain collaboration: Impact on collaborative advantage and firm performance. *Journal of Operations Management*, 29(3), 163–180. https://doi.org/10.1016/j.jom.2010.12.008

Durugbo, C., Tiwari, A. & Alcock, J.R. (2013) Modelling information flow for organisations: A review of approaches and future challenges. *International Journal of Information Management*, 33(3), 597–610. https://doi.org/10.1016/j.ijinfomgt.2013.01.009

Enstroem, R. & Benson, L. (2024) Enterprise education in undergraduate business programmes advances students' negotiating competence and self-confidence. *Education + Training*, 66(1), 54–69. https://doi.org/10.1108/ET-01-2022-0009

Enstroem, R. & Schmaltz, R. (2023) A juggler's manifesto: Elevating creativity to stay productive amid uncertainty. *Journal of Management Development*, 42(5), 340–351. https://doi.org/10.1108/JMD-04-2023-0101

Enstroem, R. & Schmaltz, R. (2024) Striking gold: Navigating the education massification maze for work readiness. *Journal of Work-Applied Management*, Ahead-of-print. https://doi.org/10.1108/JWAM-10-2023-0100

Feinstein, A.H., Mann, S. & Corsun, D.L. (2002) Charting the experiential territory: Clarifying definitions and uses of computer simulation, games, and role play. *Journal of Management Development*, 21(10), 732–744. https://doi.org/10.1108/02621710210448011

Ferrantino, M.J. & Koten, E.E. (2019) Understanding Supply Chain 4.0 and its potential impact on global value chains. Global Value Chain Development Report 103.

Fiala, M. (2009) Designing highly reliable fiducial markers. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 32(7), 1317–1324. https://doi.org/10.1109/TPAMI.2009.146

Gnimpieba, Z.D.R., Nait-Sidi-Moh, A., Durand, D. & Fortin, J. (2015) Using Internet of Things technologies for a collaborative supply chain: Application to tracking of pallets and containers. *Procedia Computer Science*, 56, 550–557. https://doi.org/10.1016/j.procs.2015.07.251

Grandzol, C. & Grandzol, J. (2018) Chantey castings: A hands-on simulation to teach constraint management and demand-driven supply chain approaches. *Decision Sciences Journal of Innovative Education*, 13(2), 6–22. https://doi.org/10.1111/dsji.12142

Kolb, D.A. (2014) *Experiential Learning: Experience as the source of learning and development*. Upper Saddle River, New Jersey: FT Press.

Li, K., Hall, M. & Bermell-Garcia, P. (2017) Measuring the learning effectiveness of serious gaming for training of complex manufacturing tasks. *Simulation & Gaming*, 48(6), 770–790. https://doi.org/10.1177/1046878117739929

Martocchio, J. & Webster, J. (1992) Effect of feedback and cognitive playfulness on performance in microcomputer software training. *Personnel Psychology*, 45(3), 553–578. https://doi.org/10.1111/j.1744-6570.1992.tb00860.x

Mor, R.S., Bhardwaj, A. & Singh, S. (2018) Benchmarking the interactions among performance indicators in dairy supply chain. *Benchmarking: An International Journal*, 25(9), 3858–3881. https://doi.org/10.1108/BIJ-09-2017-0254

Novack, R.A., Gibson, B.J., Suzuki, Y. & Coyle, J.J. (2019) *Transportation: A global supply chain perspective* (9th ed.). Mason, OH: South-Western Cengage Learning.

Paul, R. & Ponnam, A. (2018) Teaching customer experience quality and its significance in retail management: A role playing game using Chinese Puzzle 'Tangram.' *Decision Sciences Journal of Innovative Education*, 16(2), 126–139. https://doi.org/10.1111/dsji.12147

Porter, A.L. (2008) Role-playing and religion: Using games to educate millennials. *Teaching Theology & Religion*, 11(4), 230–235. https://doi.org/10.1111/j.1467-9647.2008.00468.x

ProductionAR. (n.d.) Production and workflow tracking overview, accessed February 6, 2023, available at https://www.productionar.com/tagscan

Quinn, C.N. (1996) Designing an instructional game: Reflections on quest for independence. *Education and Information Technologies*, 1, 251–269. https://doi.org/10.1007/BF02350662

Rahaman, W. (2016) Enhancing library services using barcode, QR code and RFID technology: A case study in Central Library National Institute of Technology, Rourkela. *International Journal of Digital Library Services*, 6(3), 39–50.

Shaltayev, D. (2021) Mixed-integer linear programming optimization for the Supply Chain Game. *Decision Sciences Journal of Innovative Education*, 19(4), 250–264. https://doi.org/10.1111/dsji.12247

Tripathi, R. & Dwivedi, S.K. (2021) QR code and RFID agile tags provide secure data extraction. *The American Journal of Humanities and Social Science Research*, 4(6), 70–77.

Vazquez-Briseno, M., Hirata, F.I., Sanchez-Lopez, J., Jimenez-Garcia, E., Navarro-Cota, C. & Nieto-Hipolito, J.I. (2012) Using RFID/NFC and QR-code in mobile phones to link the physical and the digital world. *Interactive Multimedia*, 12, 219–242.

Wamba, S.F. & Boeck, H. (2008) Enhancing information flow in a retail supply chain using RFID and the EPC network: A proof-of-concept approach. *Journal of Theoretical and Applied Electronic Commerce Research*, 3(1), 92–105. https://doi.org/10.3390/jtaer3010010

Webb, G.S., Thomas, S.P. & Liao-Troth, S. (2014) Teaching supply chain management complexities: A SCOR model based classroom simulation. *Decision Sciences Journal of Innovative Education*, 12(3), 181–198. https://doi.org/10.1111/dsji.12038

Wood, S.C. (2007) Online games to teach operations. *INFORMS Transactions on Education*, 8(1), 3–9. https://doi.org/10.1287/ited.8.1.3

Wyld, D.C. (2006) RFID 101: The next big thing for management. *Management Research News*, 29(4), 154–173. https://doi.org/10.1108/01409170610665022

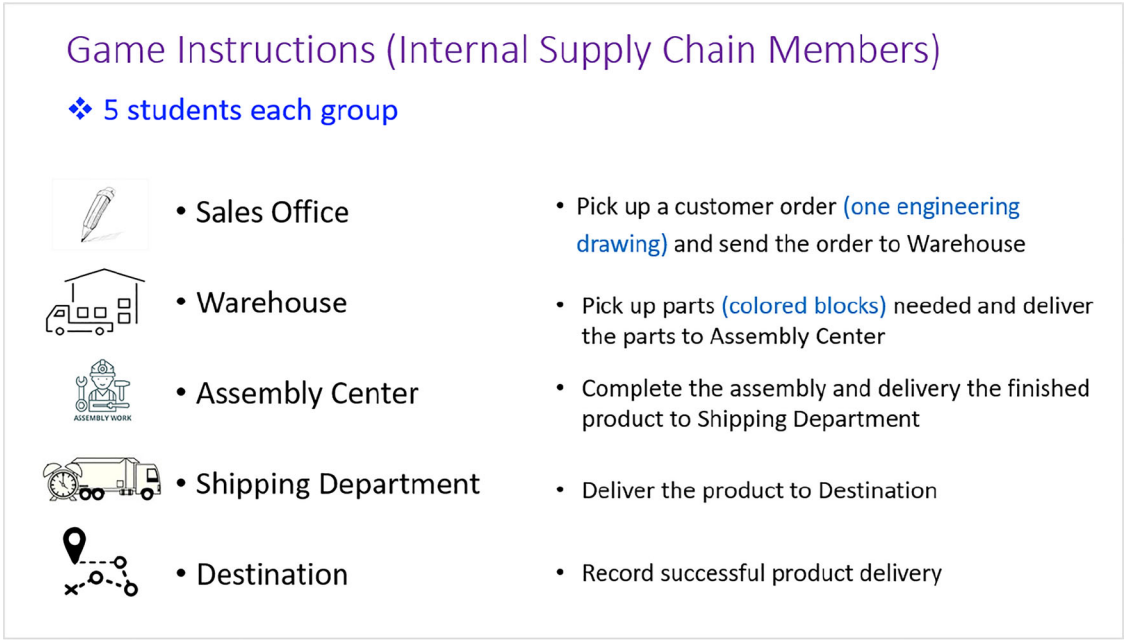
Yang, Z. & Guo, X. (2020) Teaching Hadoop using role play games. *Decision Sciences Journal of Innovative Education*, 18(1), 6–21. https://doi.org/10.1111/dsji.12197

SUPPORTING INFORMATION

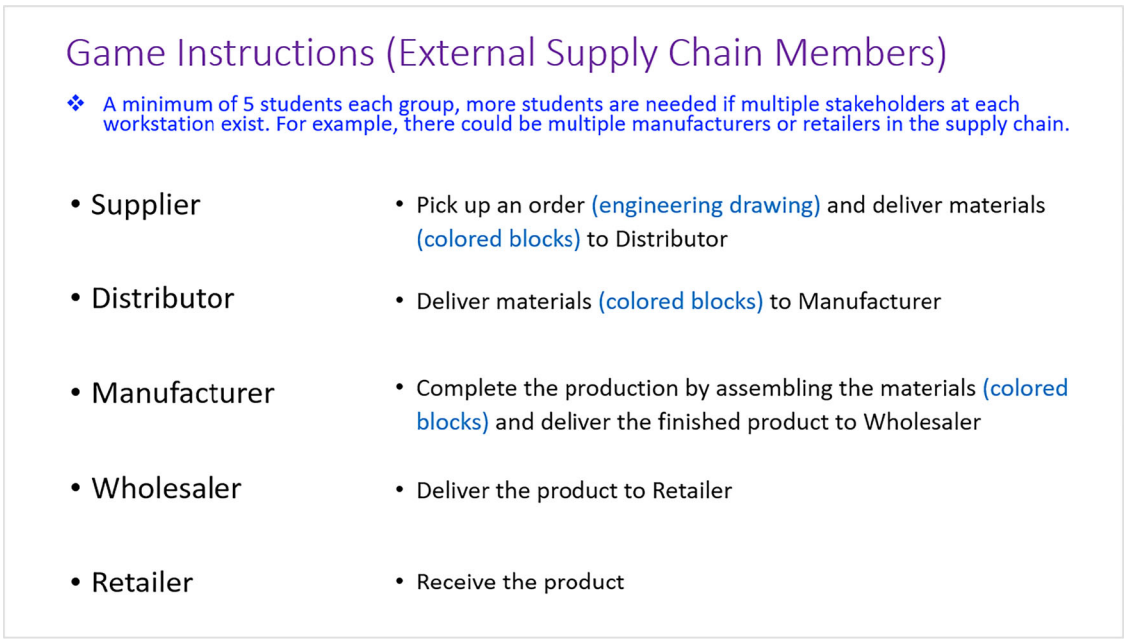
Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Wang, X. & Enstroem, R. (2024) Teaching information flow in supply chains: A role-playing game using *TagScan*. *Decision Sciences Journal of Innovative Education*, 1–15. https://doi.org/10.1111/dsji.12315

APPENDIX A: SAMPLE GAME INSTRUCTION SLIDES



Note: An instructor can easily alter the game design to involve external supply chain members. For example, the workstation roles can be changed to Supplier, Distributor, Manufacturer, Wholesaler, and Retailer, as shown in the sample slide below.



APPENDIX B: TAGSCAN INSTALLATION AND LOGIN USER MANUAL

tagscan

productionAR Augmented Reality for Industry

Welcome to TagScan

This document will walk you through the rapid install and setup.

STEP 01

Install the app

Aim your phone (in Camera mode) at this QR-Code

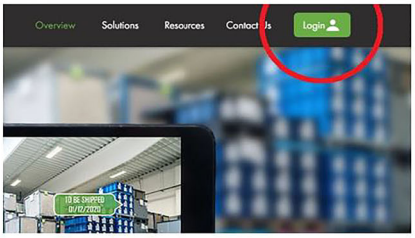
Download on the App Store

Or click this download badge on the https://www.productionar.com/ webpage.

STEP 02

Login to the app and web console

For the web console:
Go to the webpage https://www.productionar.com/
Click on the 'Login' button in the upper right of any page on the website:



Login in with the 'admin' account from the table below:

Username	Password	Purpose
tradeshow_demo_admin	password123	Full powers (except financial), reserve this for the system admin
		Useful for data uploads and downloads, and edits to data
		Typically for workers in the field –just enable Scan Mode for specific columns
		View only: e.g., in the "airport monitors". No abilities to change data.

Learn more at productionAR.com

APPENDIX C: MATCHING TABLE FOR DESIGNATED SCAN MODES

Workstation	Designated scan modes	Common scan modes
Sales office	Create new customer orders and record customer names	
Warehouse	Record parts being pulled from the warehouse	Add descriptions
Assembly	Record assembly completed	Add quarantine notes
Shipping department	Record product being shipped	Add multimedia notes
Destination	Record products received on site	

APPENDIX D: QUICK GUIDE FOR GAME PLAY USING TAGSCAN

Each mobile device should log in to the *TagScan* app before the game starts. The instructor is recommended to use a computer to manage the web console and show the cloud database on a classroom screen.

Step 1: Sales Office Role
Create a new order

- Paste a TagScan marker to an engineering drawing.
- Within the app, make sure to turn off the "Visual Distance Scan" switch in the upper left. Tap the Setting gear (lower right)—"Change to New Job Mode," then aim your phone at a targeted *TagScan* marker.
- Tap the grey circle above the targeted marker, and a window asking to confirm new job creation will pop out. After tapping "Yes," the user will hear a notification tone in the app, and a new record is added to the online database simultaneously with a short yellow flash on the new row created.

Create a customer name for the new order

- On the web console, either the student player or the instructor clicks the CustomerName field, types the desired customer name in the pop-up window, and clicks "OK."

Step 2: Warehouse Role
Pull parts from Warehouse & record it

- Pull colored blocks as parts and components for assembling the ordered product.
- Within the app, tap the Settings gear—"Select role for Scan Mode (database column)." In the list, select "Parts pulled from warehouse." Aim the phone at the same marker corresponding to the new order and tap the red circle floating above the marker.

Step 3: Assembly Center Role
Complete assembly & record it

- Perform the assembly of the colored blocks based on the engineering drawing.
- Within the app, tap the Settings gear—"Select role for Scan Mode (database column)." In the list, select "Assembly Complete." Aim the phone at the same marker corresponding to the new order and tap the red circle floating above the marker.

Step 4: Shipping Department Role
Ship the product & record the shipping information

- Perform the product delivery.
- Within the app, tap the Settings gear—"Select role for Scan Mode (database column)." In the list, select "Shipped." Aim the phone at the same marker corresponding to the new order and tap the red circle floating above the marker.

Step 5: Destination Role

Record successful product delivery

- Receive the product.
- Within the app, tap the Settings gear—"Select role for Scan Mode (database column)." In the list, select "Received on Site." Aim the phone at the same marker corresponding to the new order and tap the red circle floating above the marker.

APPENDIX E: POSTSESSION SURVEY FOR THE TAGSCAN GAME

1. What is your age? _____

2. Gender: How do you identify?
   Man Non-binary Woman Prefer to self-describe: _____

3. How many years have you been studying at MacEwan (excluding any co-op or internship durations)?
   _____

4. What is your major?
   Accounting Human Resources Management International Business
   Legal Studies in Business Management Marketing
   Supply Chain Management Undeclared

5. [If you do not have a minor, you can skip this question.] What is your minor?
   Accounting Business Intelligence Finance Human Resources Management
   International Business Innovation and Entrepreneurship International Business
   Legal Studies in Business Management Marketing Property Management
   Supply Chain Management Others: _____

6. I think the concept of information flow is abstract.

Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

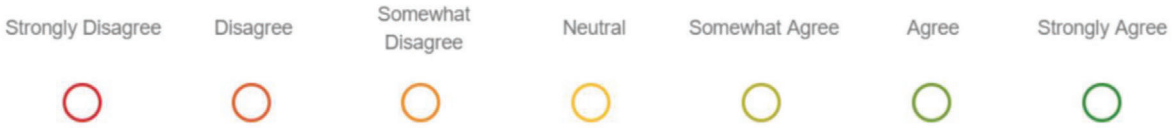
7. I understand the concept of information flow in a supply chain context.

Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

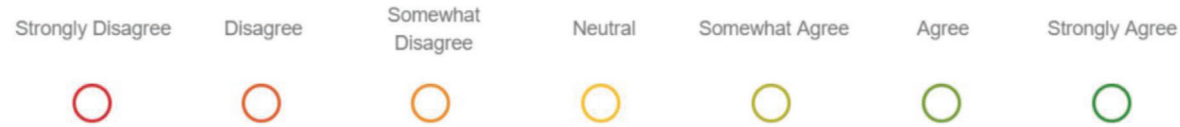
8. I understand what types of information can be tracked in a supply chain.

Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

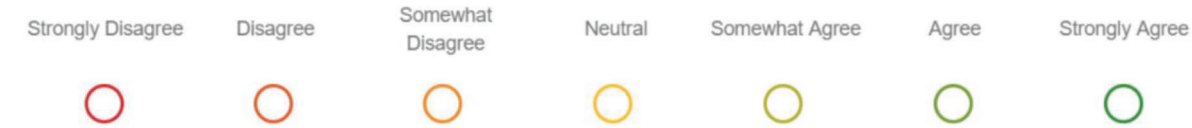
9. I understand what kind of technology is available for information transmission in a supply chain.



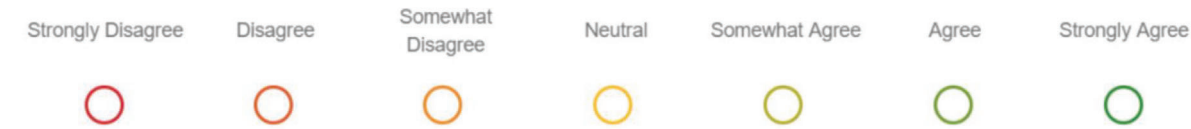
10. I understand the dynamics of information transmission in a supply chain.



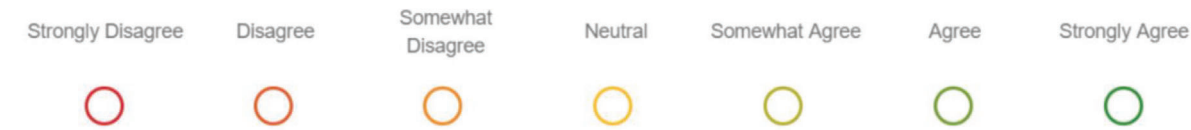
11. Having the opportunity to use newly-developed tracking technology (i.e., TagScan) is fun.



12. I have learned something new from the TagScan simulation game.



13. The TagScan simulation game was an engaging classroom exercise.



14. Do you have any comments and feedback for the guest lecture and simulation game? Thanks for your sharing and thoughts!

AUTHOR BIOGRAPHIES

Dr. Xiaojia Wang is an assistant professor in the Department of Decision Sciences, MacEwan University, Canada. She specializes in teaching Supply Chain Management Major courses including transportation management. Dr. Wang actively participated in critical community-engaged events, such as MacEwan's 2023 Supply Chain Knowledge Mobilization Summit, supported by Alberta Innovates and Sturgeon County. Her research focuses on applying operations management principles to enhance business practices and examines how various business practices shape the operational performance of focal firms and their supply chains. Dr. Wang also serves as an editorial board member for the *International Journal of Applied Management Sciences*.

Dr. Rickard Enstroem, associate professor at MacEwan University, Canada, and former chair of the Department of Decision Sciences, initiated the Business Intelligence Minor in the Bachelor of Commerce program. He has collaborated with Supply Chain Canada, serving on advisory and reference groups for several critical projects, including the Supply Chain Mapping Tool and digital competency standards for the SCMP designation. His research encompasses judgment and decision-making, human-tech interface, and management development. He is an associate editor for the *Journal of Management Development*.