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Abstract
Understanding how the execution of the supply chain business processes affect the financial performance a firm is key to running a successful enterprise. These processes are integrated across many functional groups within a business organization, and it is difficult to illustrate this integration in a classroom setting. This paper presents a case study of teaching supply chain operations and business analytics using the cloud-based SAP ERPsim manufacturing game. Although teaching about enterprise systems is often classified as part of the MIS or accounting domain, the ERPsim simulation encompasses the primary supply chain business processes, and because the enterprise system on which it is based captures the financial impact of supply chain transactions during the simulation, it is an ideal tool to teach supply chain operations, financial integration, and analytics. The results of this preliminary study demonstrate that there is a significant improvement in graduate supply chain students' knowledge and understanding of the impact of supply chain operations on financial performance.

Introduction

Understanding the link between execution of the supply chain core business processes and the financial performance of firms is key to running a successful organization. There are many common definitions of the supply chain, most of which focus on the customer-facing distribution/logistics function. While these are part of a supply chain, the formal definition is based on the supply chain operations reference (SCOR) model and includes the following core business processes: plan, source, make, distribute, return, and enable (ASCM, 2017). These processes are integrated across many functional groups within a business organization. Demonstrating this integration and its financial consequences in a classroom setting is challenging because courses are taught by discipline (accounting, marketing, finance, etc.) and students often miss the connections between them.

For example, to produce products for sale, Marketing first provides demand forecasts. Operations uses these forecasts to determine production rates and material requirements, and purchase requisitions are sent to Sourcing to obtain those materials. Once the materials are received the production process can begin, which culminates in sales and distribution of the finished product. Meanwhile Financial Accounting is responsible both for paying the invoice from the supplier and collecting the revenue from the sale of the finished product. This sequence of events impacts the firm's cash flow in numerous ways, which in turn impacts the financial performance of the company.

Virtually all supply chain management curricula acknowledge this integration and emphasize the importance of coordinating activities to promote the efficient operation of the supply chain. Yet while the economic impact of each of the core processes is described, the integration of these processes with financial results is often limited. This is due in part to the difficulty of quantifying the overall financial performance of a supply chain in an academic setting.

A recent survey of undergraduate and MBA syllabi for supply chain management (SCM) courses identified the lack of analytics and data science applications in SCM courses as an emerging issue in preparing business school graduates for professional careers (Sinha et al., 2016). To address this, many business schools have developed an analytics curriculum based on tools provided by enterprise software producer SAP (McLeod et al., 2017). These curricula provide students with hands-on experience using the same tools as industry professionals. That experience can give students an advantage during job search activities. However, in many cases analytics are taught as a separate "tools" course where students learn visualization, statistics, regression analysis, and basic linear optimization, among other topics. The need to integrate supply chain operations with analytics and financial analysis led to the creation of the course on which this study is based. The course combines experiential learning using a real-time supply chain simulation with business analytics, specifically to teach methods by which to improve the financial performance of supply chains.

One way to demonstrate business process integration and show how they impact the financial performance is by using enterprise resource planning (ERP) software. Although this adds a topic that is not as commonly taught in supply chain courses, it has the advantage of most closely resembling what students will experience in a professional environment. This paper presents a case study of teaching supply chain process integration and analytics to supply chain business students using the cloud-based SAP ERPsim manufacturing game (Léger et al., 2021). The course objective is to demonstrate the integration of supply chain business processes with financial results using analytical tools. It has been taught successfully in face-to-face and remote synchronous formats at the graduate level (a similar though less intensive course is taught at the undergraduate level), and student feedback has been very positive.

Literature review

A study of business school teaching methods comparing lectures, cases studies and simulations showed that students perceived simulations as the most effective teaching tool (Farashai & Tajeddin, 2018). Simulations have also been shown to encourage positive student attitudes towards entrepreneurship (Zulfiqar et al., 2018, p. 121). Additionally, simulations have become an important experiential learning tool for teaching enterprise systems (Ruhi, 2016). One of the most popular enterprise simulation tools is ERPsim, which was originally developed at HEC Montreal (Leger, 2006). It uses a standard SAP ERP system to manage the business processes of virtual companies that compete with each other to produce, distribute and sell breakfast cereals or dairy products in a simulated market.

While the use of enterprise system simulation is widespread in MIS (Management Information Systems), accounting and computer science courses, it is less common in the supply chain domain. This is partly because ERP systems are usually categorized as "information systems" rather than (correctly) as tools for managing the business processes of a supply chain. A study of supply chain

simulations (Schmuck, 2021) partitioned these tools into two groups: manufacturing simulation games and supply chain/logistics simulation games. The only enterprise simulation listed was the ERPsim manufacturing game, and it was described as being an inventory and logistics simulation although it involves the planning and production processes as well. Several other popular games focus on a particular business process, such as forecasting or network design, but the opportunity to perform analytics is limited and there is almost no financial integration.

Because the ERPsim manufacturing game encompasses most of the supply chain core processes, and because the enterprise system on which it is based captures accounting data for each business activity, it is an ideal simulation tool to teach how supply chain operation impacts financial results. Previous studies in MIS and computer science courses have suggested it is effective in teaching students ERP concepts, business processes, and accounting transactions (Cronan & Douglas, 2012; Charland et al., 2016; Hwang & Cruthirds, 2017). Other research has described the use of the ERPsim logistics simulation as an experiential learning or problem-based learning tool (Duncan & Lindoo, 2019; Angolia & Pagliari, 2018), to introduce business analytics (Wang, 2018), or to teach decision-making skills (Paulet & Dick, 2019). However, this study is different because it is based on a supply chain management course that focuses on all the core business processes (not just logistics) and the financial impact of those activities on overall firm performance.

Course design

Objectives

The course on which this case study is based is a graduate elective at a large southwestern business school titled "Analytics and Enterprise Operations". It is a required course in the MS Supply Chain (MS SCM) program although it also attracts MS MIS and MBA students. Students in the MS SCM program come from various undergraduate backgrounds (e.g., engineering) and many of them have not taken any accounting or finance courses. These courses are part of the MBA curriculum, but they are not included in the MS SCM curriculum. Consequently, this course covers basic accounting processes and finance topics such as net present value because understanding how operating decisions affect cash flow is critical to improving supply chain performance. There are three primary objectives for the course:

- **Supply chain operations**: Explain how enterprise systems enable the integration and execution of multi-functional business processes.
- **Analytics**: Develop and use analytical tools (descriptive, predictive and prescriptive) for better decision making by running the supply chain of a simulated manufacturing company.
- **Performance analysis/improvement**: Describe how supply chain decisions impact the financial performance of the firm.

At the end of term students are required to submit a final project summary as a written report and presentation. The instructor requires this report to be formatted similar to an annual report to investors. It covers the financial result they obtained during the simulation along with a detailed explanation of their strategy and how they used analytics to improve their performance during the simulation. During the presentation portion they have an opportunity to answer questions from

investors (i.e., other students and the instructor) about why they chose to make certain decisions and what they would do differently given their experience managing the supply chain.

Supply chain operations

As a member school in the SAP University Alliances the university has access to several fully functional SAP S/4 systems that allow it to give students practical experience using them. These systems are hosted at the University of Wisconsin (Milwaukee), and students access them using a standard web-browser interface which enables them to use a variety of platforms: PC's, Mac's, tablets and even smartphones. Because most students have little – if any – familiarity with SAP the initial class sessions consist of learning about business processes in general and how SAP enterprise software (S/4) enables consistent execution of these processes. Using a reference textbook as a guide (Magal & Word, 2011), students execute standard transactions that update data on an actual SAP client. These transactions use SAP-assigned codes, such as VK32 (product pricing) and MD61 (Material Requirements Planning (MRP) execution), that are common to all SAP implementations. Apart from one course at the undergraduate level and a brief discussion in an MIS course at the graduate level, this is the only other course in the business school that provides students with any exposure to enterprise systems and SAP.

During this part of the course students are also introduced to descriptive analytics using three visualization tools: Tableau, Power BI and SAP Lumira/Expert Analytics[1]. The visualization exercises that accompany this SAP introduction challenge students to begin simple data mining analytics by asking questions such as "Which product had the lowest sales volume?" or "Display the revenue trend over the past 12 months." This encourages them to ask more detailed questions on their own during the simulation activities to follow.

After completing the introduction to SAP, students are divided into 4-person teams that compete against each other in the real-time ERPsim manufacturing simulation producing 6 types of breakfast cereal in two box sizes. As many as 26 teams can compete simultaneously in a simulation, but class enrollment usually limits the number of teams to between 6 and 10. Simulation activities take place in three multi-round tranches starting with an introductory game. This first simulation familiarizes students with the products, the manufacturing steps, and the key business processes they will execute to manage the supply chain: planning (forecasting, and MRP), procurement, production, sales, and distribution (pricing and marketing). These activities are shown below in Figure 1, along with the data and reports produced by the simulation. All teams produce identical products from a limited product slate and sell through a single distribution channel.

[1] While Tableau supports both Windows and Mac OS, students who have Mac's and want to use Power BI or SAP Lumira must do so using windows emulation software such as Boot Camp, Virtual Box or VMware Fusion.

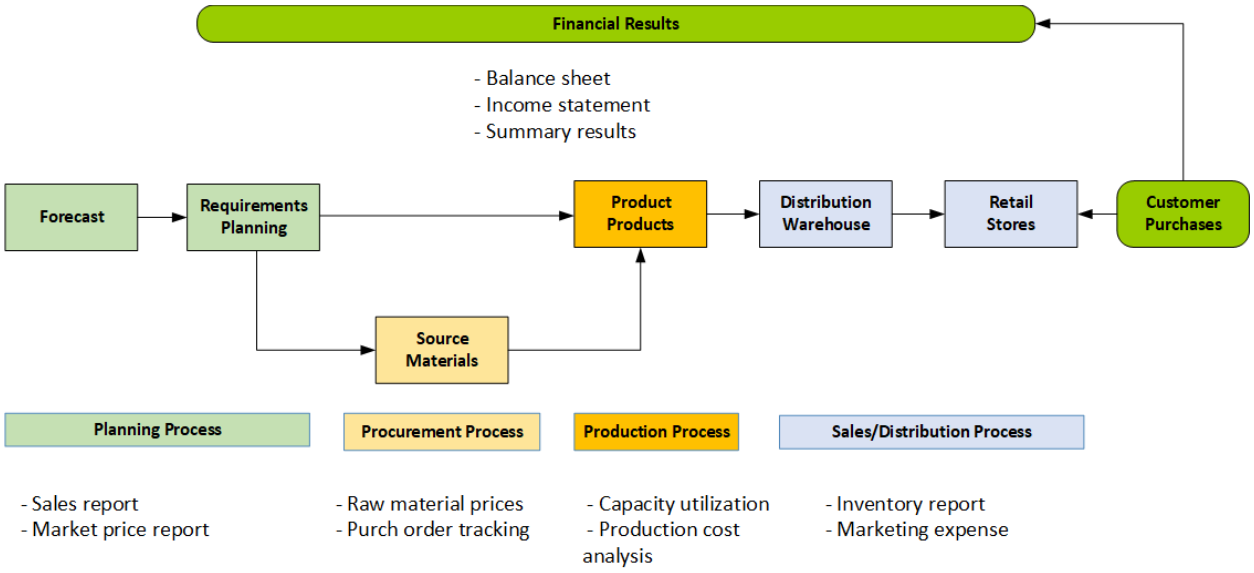

Figure 1: Manufacturing Simulation Business Processes

Analytics

During the introductory simulation activities students learn how to obtain real-time data from the SAP HANA database using the visualization tools and Excel. Because so much is happening during the simulation we encourage students to rotate analysis duties among themselves during the rounds. For example, a typical treemap visualization showing the sales volumes of each product, with the size of the area proportional to sales quantity, appears below in Figure 2. This visualization shows that the 500g Nut and 500 g Blueberry Muesli have the highest sales volumes, and the 1kg Strawberry and 1 kg Raisin Muesli have the lowest volumes.

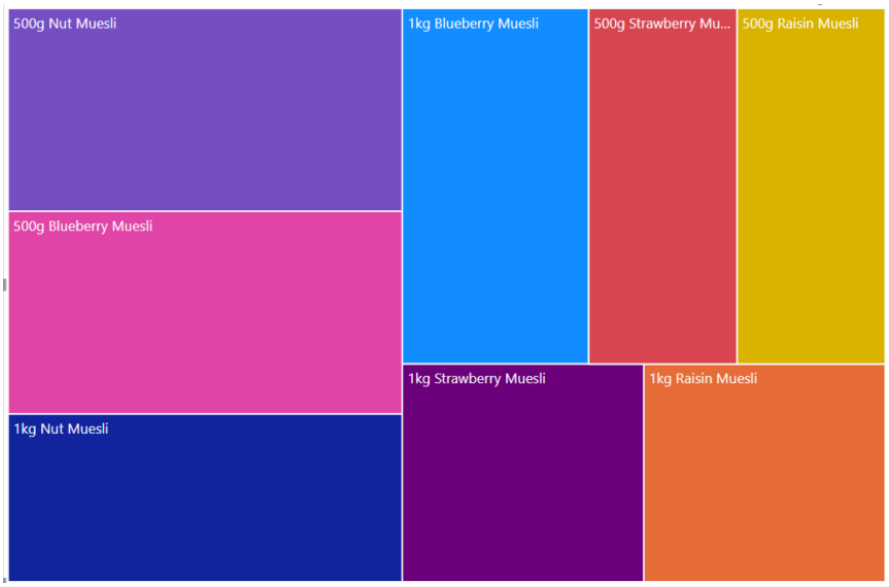

Figure 2: Sales Volume by Product

After becoming familiar with the manufacturing supply chain business processes, the simulation is expanded to encompass a more fully developed supply chain. First, the product slate is expanded to include all 12 potential products, and teams can customize their products by changing the product recipes (i.e., bills of material). There are additional distribution channels available which only purchase specific-sized packages, and teams can expand production capacity or invest in other manufacturing improvements. After a few rounds, the supply chain is expanded again to include a distribution system consisting of three geographic warehouses. This requires teams to implement a distribution strategy that is either "push" (send a fixed amount to each warehouse on a regular schedule) or "pull" (replenish warehouse inventories based on past sales).

The purpose of these extended simulations is to illustrate in greater detail how supply chains operate, and how analytics can be used to manage supply chain operations and improve performance. Prior to starting the expanded simulations teams must articulate a strategy, identify the critical success factors (CSF's) that will enable them to execute the strategy successfully, and determine what key performance indicators (KPI's) they can track to measure whether they are achieving those objectives. For example: A team decides that it wants to be a low-cost competitor in the market. To do this their supply chain must control costs, minimize downtime, and sell high volumes of product. Some appropriate KPI's for this strategy would include: allocated fixed cost/unit, % downtime, and market share by volume, among others.

Students can see how well they are executing their team's production and distribution strategy by tracking their product inventory levels during the simulation. Figure 3 below illustrates how inventories dip periodically as product is shipped to the various distribution warehouses, while periodic increases are due to new production replenishing stocks. Although students understand the importance of avoiding product stockouts, they often have difficulty managing their production schedules to prevent them from happening, as shown towards the end of the round in the figure. This illustrates the value of using a simulation because students develop a better understanding of why this happened when they analyze the operating decisions that led to this result.

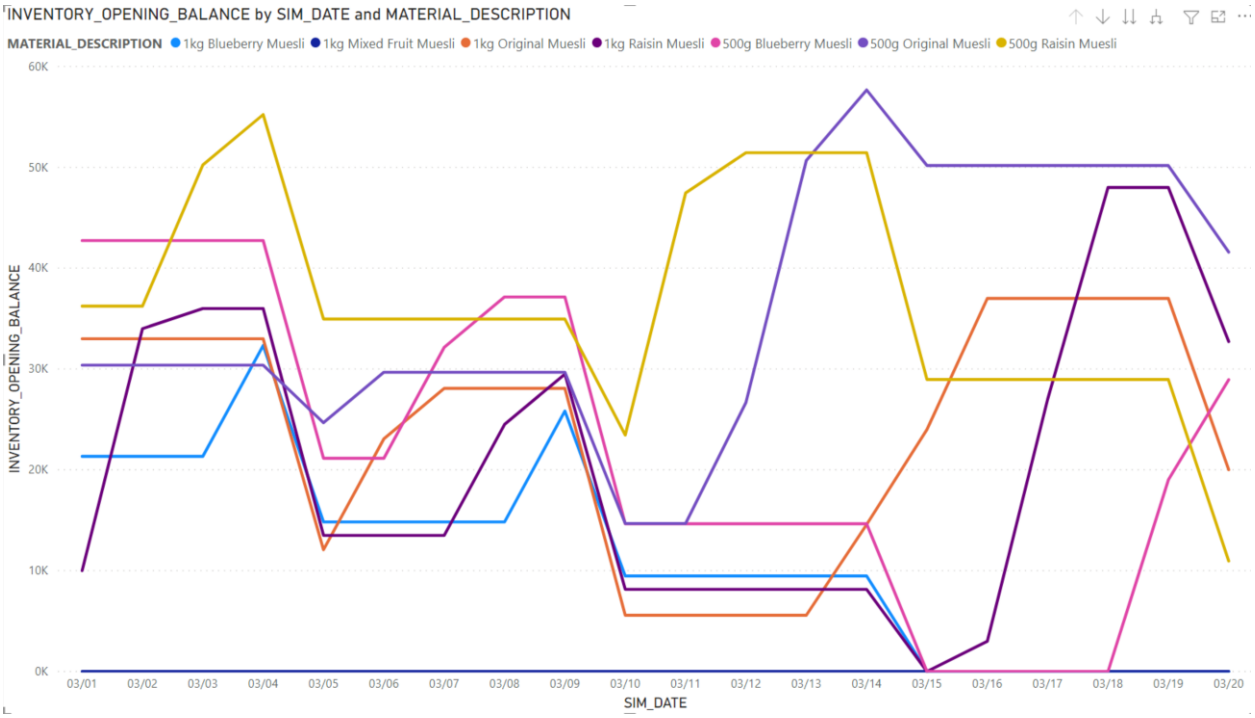

Figure 3: Product Inventory Levels

Performance analysis/improvement

Because the financial results of all the supply chain processes are captured in the ERPsim database, students can access them readily to perform analytics. Although many transactions do not have a financial impact, one that does is manufacturing capacity utilization. This metric calculates the ratio of the number of units produced in a period of time to the maximum production rate. Knowing the capacity utilization, students can then determine the allocated fixed cost per unit. As shown in Figure 4, a utilization rate of 75% would result in a fixed cost per unit of € 1.35. By increasing productivity from 75% to 90% students can see how the allocated cost declines and margins improve. Note that all financial transactions are denominated in Euros, which introduces a global feature to the simulated supply chain.

	A	B	C
1	**Fixed Cost Analysis**		
2			Cost (daily)
3		Labor	4,000.00 €
4		Manufacturing Overhead	3,000.00 €
5		Depreciation - Equipment	10,000.00 €
6		Depreciation - Building	250.00 €
7		Sales, General & Administrative	4,000.00 €
8		Loan Interest	3,000.00 €
9		Total Fixed Cost	24,250.00 €
10			
11		Production Capacity	24,000
12		Productivity (%)	75%
13		Allocated Basis	18,000
14			
15		Allocated Fixed Cost per Unit	1.35 €
16			

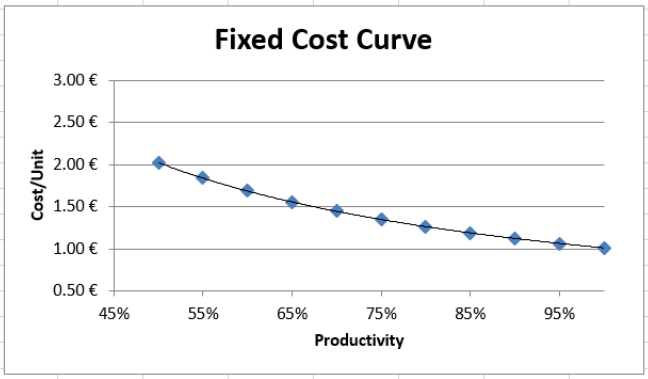

Figure 4: Calculation of Allocated Fixed Cost/Unit

A summary of all teams' financial and operating performance is posted at the end of every round of the simulation. Among the results included in the summary are: total sales revenue for the round, cumulative net income, sales margins, returns on equity and assets, and manufacturing productivity. Students can see not only how their team is performing, but also where they rank relative to the other teams. This gives students an incentive to analyze their performance between rounds so that they can compete more effectively during the next round. It also provides the instructor with an opportunity to identify the teams that are underperforming and address any problems they may be having.

During the advanced simulation students also read and discuss business articles and analyze selected case studies to complement the experiential learning from the simulation. The articles begin with an introduction to supply chain analytics (Souza, 2014), and progress into discussions of management roles and responsibilities as consumers of analytics (Ransbotham et al., 2015; Davenport, 2013) and ways to apply analytics to improve performance (Kaplan & Norton, 2007). These and other readings are matched with case studies that illustrate some of the challenges in building and maintaining analytical processes within organizations, as well as examining how companies use analytics in customer relationship management and to get value from big data.

Final project

The final project for the course consists of the aforementioned written report and presentation by each team of an "Annual Report to Shareholders" with the members of the other teams and invited guests (such as other business school faculty) acting as the shareholders. Because the score for the simulation activity is based on the quality of the analysis, and not on the simulated performance result, students usually put considerable effort into the analysis. Requirements for the analysis include: 1) an initial strategy statement, 2) a description of the critical success factors and initial key performance indicators that support that strategy, 3) a detailed analysis of performance that links specific supply chain execution decisions to financial results (see Figure 5 for example operating and financial KPI's that track financial performance; c.f., Dunaway, 2011) and a justification for any changes in strategy, and 4) correctly presenting the financial statements, including an analysis of working capital and cash flows (see Figure 6), using financial data from

the simulation. Presentations take place during the last class of the semester, and students often engage in extended discussions over various team strategies and how the financial results did or did not meet their expectations.

Production and Inventory metrics		**Actual**			
KPI	**Target**	**Q1**	**Q2**	**Q3**	**Q4**
Capacity utilization	75%	66.7%	71.4%	82.9%	77.8%
Total setup time	min	96 hr.	90 hr.	77 hr.	82 hr.
Average fixed cost	1.69	1.90	1.78	1.53	1.63
Inventory turns	3.0	2.0	2.7	3.4	3.1
% Stockouts	min	NM	7	3	2
Days Sales Outstanding (DSO)	< 15	18.6	20.2	17.3	13.5
Days of Inventory (DOI)	< 7	7.3	6.4	8.1	9.6
Days Payable Outstanding (DPO)	> 10	0	11.7	10.3	9.1

Figure 5: Example Key Performance Indicator Summary

	A	B	C
1	**Statement of Cash Flows for Simulation**		
2			
3	**Cash flows from operating activities:**		
4	Net income (loss)		2,274,396.12
5	Adjustments to reconcile net income (loss) to net cash provided by operating activities		
6	Depreciation and amortization		
7	Building	318,181.92	
8	Equipment	272,727.60	
9	Changes in working capital		
10	Accounts receivable	(1,783,259.50)	
11	Finished inventories	(297,181.40)	
12	Raw material inventories	(6,567.42)	
13	Accounts payable	310,244.31	
14	Net cash provided by operating activities		1,088,541.63
15			
16	**Cash flows from investing activities:**		
17	Expenditures for property, plant and equipment	-	
18	Net cash provided by (used in) investing activities		-
19			
20	**Cash flows from financing activities:**		
21	Repayment of debt		
22	Dividends paid		
23	New debt issued (bank loans)	329,111.89	
24	Net cash provided by (used in) financing activities		329,111.89
25			
26	**Increase (decrease) in cash and cash equivalents**		1,417,653.52
27	Cash and cash equivalents at beginning of simulation		3,000,000.00
28	Cash and cash equivalents at end of simulation		4,417,653.52

Figure 6: Statement of Cash Flows for Simulation

There are several activities used to assess student performance. Individual activities include assigned exercises using SAP and visualization analytics, a mid-semester assessment focusing on enterprise systems and business processes, and an analysis of one of the assigned readings. Group

activities include an analysis and presentation of one of the assigned case studies and the final project. These activities are weighted so that individual effort accounts for 50 – 60% of overall performance.

Results

Students were surveyed at the beginning and end of the course to determine how effective the course was in meeting the established learning objectives. The surveys used a 7-point Likert scale (7 = very high, 1 = very low) administered over two semesters. Because participation in the surveys was voluntary some students only completed the first survey while a few students who did not participate in the first survey completed the second. If the surveys could not be matched up, the survey data was discarded. This resulted in 26 usable responses out of 45 total students, for a response rate of 57.8%. Student undergraduate majors were: engineering (38.5%), business (38.5%), liberal arts/social science (19.2%) and science/mathematics (3.8%). Students self-identifying as female represented 15.4% of the responses.

Table 1 summarizes the key survey questions regarding SAP, supply chain finance and business analytics. The financial measures (4 – 6) are particularly important since many students do not have prior knowledge of financial processes, as evidenced by the medium/medium low response mean of 3.88 on item 5 at start of course. Based on the paired t-test results, there was significant improvement ($p < .05$) in all measures except attitude about SAP's ease of use (item 2, $p < .15$) and attitude towards supply chain analytics (item 10, $p < .10$). The latter result may be partly explained by the fact that students in the course already have a favorable attitude towards supply chain analytics (medium high/high mean = 5.81 on item 10 at start of course) leading to less opportunity for improvement.

	Start of Course		**End of Course**			
	Mean	**SD**	**Mean**	**SD**	**t-statistic**	**p-value**
1. Ability to accomplish supply chain transactions in SAP	2.54	1.77	5.54	1.07	8.25	0.000
2. Attitude about SAP's ease of use	4.23	1.53	4.92	1.38	1.63	0.116
3. Overall attitude towards SAP	4.50	1.73	5.69	1.09	2.98	0.006
4. Knowledge of financial terminology	4.19	1.50	5.38	1.17	2.87	0.008
5. Knowledge of financial processes	3.88	1.28	5.23	1.18	3.47	0.002

6. Knowledge of supply chain process financial impact	5.08	1.02	5.88	0.82	3.10	0.005
7. Knowledge of analytics terminology	4.50	1.27	5.65	1.20	2.98	0.006
8. Knowledge of analytics processes	4.50	1.33	5.58	1.14	2.62	0.015
9. Ability to interpret analytic results	4.69	1.44	5.88	0.99	3.44	0.002
10. Attitude towards supply chain analytics	5.81	1.44	6.50	0.71	1.93	0.065

Table 1: Analysis of Course Learning Objectives

Student response to the course has been almost universally positive. Although most students have little or no experience using SAP at the start of the course, they quickly learn how to use important transactions, and they can see how enterprise systems are used to execute supply chain business processes. In addition, they gain experience using analytics to improve supply chain performance. Finally, both the individual readings and case assignments challenge them to think more critically about business issues and communicate their thoughts and recommendations in clear and concise terms. A representative selection of student comments is provided below:

> "Our [primary] takeaway from this simulation is the fact that there is a financial impact for every decision made in the supply chain."
>
> "Throughout the simulation, we have learned about the interconnectedness of all of the business elements that are involved in the supply chain process, how to utilize real- time data and analytics to our advantage, as well as the value of human capital."
>
> "… one of the most critical learnings that we had was interpreting and making use of the data into actual strategy implementations."
>
> "To maintain competitive advantage, you have to adjust your strategy, watch the market and competition, and analyze the data given."
>
> "I thought that the simulation was a valuable learning tool in this class because it gave us the most feasible 'real world' experience that one can reasonably gain in a classroom setting."
>
> "The most essential lesson learned from the simulation … was that 'Productivity' is the key to success."

Conclusions and future research

Prior studies (Cronan et al., 2011, Angolia & Pagliari, 2018) have shown how the ERPsim manufacturing simulation has been used to teach how business processes are integrated, and how to enterprise systems are used to manage supply chain operations. These studies focused on the effectiveness of using the ERPsim simulation to teach SAP mainly in MIS or accounting courses. But there is a lack of studies investigating the integration of supply chain process knowledge with an appreciation of the financial consequences of supply chain operating decisions in supply chain management courses. One reason for this may be the difficulty in effectively demonstrating the link between supply chain operating decisions and firm financial performance.

This study demonstrates the effectiveness of using the ERPsim simulation in a graduate supply chain course to teach ways of analyzing and improving supply chain performance. By analyzing the operating and financial data captured in the SAP database that is generated during the simulation, in particular analyzing changes to working capital and the effect on cash flow, students develop an appreciation of the financial impact of their operating decisions. Furthermore, all teams have an opportunity to see and critique the decisions made by their competitors during the final project presentations. These presentations are an effective peer-instruction exercise that facilitates student engagement and class participation.

Because the simulation is a cloud-based/browser application, it is independent of the hardware platform students choose. This avoids issues with software compatibility and maintenance, although students may choose to use analytical tools that require a specific operating system. The competitive nature of the simulation engages students in real-time decision making, and it allows them to make mistakes in a controlled environment. In fact, some of the best project reports have been submitted by the teams that experienced the most problems during the simulation and discovered ways to improve their performance as a result of diagnosing their problems.

There are a few pre-requisites to employing this simulation tool effectively. First and foremost is the instructor knowledge of SAP and the simulation tool itself. Fortunately, the ERPsim Lab at HEC Montreal provides excellent training and resources for instructors. Similarly, students need to have some familiarity with the SAP transactions they will use during the simulation, and they need to be able to communicate in real-time with the other members of their team. The simulation is most effective when students use the reporting and other analytical tools during the simulation to get feedback on their supply chain performance. Finally, having uninterrupted Internet access during the simulation is highly desirable although intermittent outages can be dealt with on an ad-hoc basis.

An extended study that builds and expands upon the results in this preliminary study specific to the supply chain domain is currently underway. The purpose of the new study is to assess in greater detail students' understanding of the links between supply chain activities and financial performance. It will examine the factors that influence students' ability to take actions that improve the financial results of their simulated supply chain. Among these factors are: 1) ability to read, understand and infer conclusions about performance from financial documents; 2) ability to use analytical methods to assess supply chain and financial performance; and 3) understanding which actions to take to improve supply chain performance. With these two studies, the knowledge base

that supports ERP simulation as a key tool to demonstrating the link between manufacturing operations and financial results will be established.

References

Angolia, M. G., & Pagliari, L. R. (2018). Experiential Learning for Logistics 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

ASCM SCOR Model. (n.d.). Retrieved January 16, 2022, from https://scor.ascm.org/processes/introduction

Babin, G., Léger, P.-M., Robert, J., & Bourdeau, S. (2011). ERPsim BI: A problem-based learning approach in teaching business analytics. *The Proceedings of DYNAA*, *2*(1), 1–7.

Bhuiyan, S., Goodarzi, S., Large, J., Serrano, C., & Bristow, S. (2018). *Understanding ERP learning success in flipped classrooms*. Proceedings of the 24th Americas Conference on Information Systems (New Orleans, LA).

Charland, P., Léger, P.-M., Cronan, T. P., & Robert, J. (2016). Developing and Assessing Erp Competencies: Basic and Complex Knowledge. *Journal of Computer Information Systems*, *56*(1), 31–39. https://doi.org/10.1080/08874417.2015.11645798

Cronan, T. P., Douglas, D. E., Alnuaimi, O., & Schmidt, P. J. (2011). Decision Making in an Integrated Business Process Context: Learning Using an ERP Simulation Game: Teaching Brief. *Decision Sciences Journal of Innovative Education*, *9*(2), 227–234. https://doi.org/10.1111/j.1540-4609.2011.00303.x

Cronan, T. P., & Douglas, D. E. (2012). A Student ERP Simulation Game: A Longitudinal Study. *Journal of Computer Information Systems*, *53*(1), 3–13. https://doi.org/10.1080/08874417.2012.11645591

Cronan, T. P., & Douglas, D. E. (2013). Assessing ERP Learning (Management, Business Process, and Skills) and Attitudes. *Journal of Organizational and End User Computing*, *25*(2), 59. http://dx.doi.org.ezproxy.lib.uh.edu/10.4018/joeuc.2013040104

Davenport, T.H. (2013). Keep up with your quants. *Harvard Business Review, 91 (7/8), 120 – 123*.

Dick, G. N., & Akbulut, A. Y. (2020). Innovative Use of the ERPsim Game in a Management Decision Making Class: An Empirical Study. *Journal of Information Technology Education*, *19*.

Dunaway, M.M. (2011). Understanding the Relative Influence of Several Factors on ERP Simulation Performance: An Exploration of Ecological Validity. *Developments in Business Simulation and Experiential Learning, 38*, 367 – 372.

Duncan, D., & Lindoo, E. (2019). *Evaluating student learning through problem-based learning using an ERP simulation game*. Papers of the 28th Annual CCSC Rocky Mountain Conference (Sioux Falls, SD).

Farashahi, M., & Tajeddin, M. (2018). Effectiveness of teaching methods in business education: A comparison study on the learning outcomes of lectures, case studies and simulations. *The International Journal of Management Education, 16*(1), *131–142*. https://doi.org/10.1016/j.ijme.2018.01.003

Hwang, M., & Cruthirds, K. (2017). Impact of an ERP simulation game on online learning. *The International Journal of Management Education, 15(1), 60–66.* https://doi.org/10.1016/j.ijme.2017.01.004

Jheengut, K., Cauleechurn, D., & Cadersaib, Z. (2020). *Teaching Methods Used for ERP – Focus on Gamification* (SSRN Scholarly Paper ID 3708880). Social Science Research Network. https://doi.org/10.2139/ssrn.3708880

Kaplan, R.S., & Norton, D.P. (2007). Using the balanced scorecard as a strategic management system. *Harvard Business Review, 85 (7/8), 150 – 161*.

Labonte-LeMoyne, E., Leger, P.-M., Robert, J., Babin, G., Charland, P., & Michon, J.-F. (2017). Business intelligence serious game participatory development: Lessons from ERPsim for big data. *Business Process Management Journal*.

Leger, P.-M. (2006). Using a simulation game approach to teach enterprise resource planning concepts. *Journal of Information Systems Education, 17 (4), 493 – 505*.

Leger, P.-M., Robert, J., Babin, G., Lyle, D., Pellerin, R., & Wagner, B. (2021). *Participant's Guide—Manufacturing Game | ERPsim Lab*. (n.d.). Retrieved December 27, 2021, from https://erpsim.hec.ca/en/node/291

Magal, S., & J. Word (2011). *Integrated Business Processes with ERP Systems, 1st Edition | Wiley*. (n.d.). Wiley.Com. Retrieved December 28, 2021, from https://www.wiley.com/en-us/Integrated+Business+Processes+with+ERP+Systems%2C+1st+Edition-p-9780470478448

McLeod, A. J., Bliemel, M., & Jones, N. (2017). Examining the adoption of big data and analytics curriculum. *Business Process Management Journal*, *23*(3), 506–517. https://doi.org/10.1108/BPMJ-12-2015-0174

Paulet, G., & Dick, G. (2019). ERPsim Games in Management Higher Education. *Developments in Business Simulation and Experiential Learning: Proceedings of the Annual ABSEL Conference, 46*. https://absel-ojs-ttu.tdl.org/absel/index.php/absel/article/view/3241

Ransbotham, S., Kiron, D., & Prentice, P.K. (2015). Minding the Analytics Gap. *MIT Sloan Management Review, 56 (3), 63 – 68*.

Ruhi, U. (2016). An experiential learning pedagogical framework for enterprise systems education in business schools. *The International Journal of Management Education*, *14*(2), 198–211. https://doi.org/10.1016/j.ijme.2016.04.006

Schmuck, R. (2021). Education and training of manufacturing and supply chain processes using business simulation games. *Procedia Manufacturing*, *55*, 555–562. https://doi.org/10.1016/j.promfg.2021.10.076

Souza, G.C. (2014). Supply chain analytics. *Business Horizons*, 57, 595 – 605.

Sinha, A., Millhiser, W. P., & He, Y. (2016). Matching supply with demand in supply chain management education. *The International Journal of Logistics Management*, *27*(3), 837–861. https://doi.org/10.1108/IJLM-03-2015-0058

Wang, M. (2018). Real time data analytics and decision making in ERP game simulation: An across disciplinary approach. *Issues in Information Systems*, *19*(4).

Zulfiqar, S., Sarwar, B., Aziz, S., Ejaz Chandia, K., & Khan, M. K. (2019). An analysis of influence of business simulation games on business school students' attitude and intention toward entrepreneurial activities. *Journal of Educational Computing Research*, *57*(1), 106–130.