

Breathing Life into Business Concepts: Utilizing Simulations in Management Information Systems

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Abstract

The Department of Computing at East Tennessee State University provides students exposure to the enterprise application SAP as a part of the Information Systems curriculum. Over the past two years, the use of SAP has expanded beyond the Department of Computing into the Management Information Systems course offered by the Department of Management and Marketing. By transforming the MIS course, students gain the opportunity to utilize the SAP environment through the business simulation ERPsim. This simulation emphasizes the importance of enterprise applications and the importance of data in a business. Furthermore, students learn to apply business concepts such as Porter's Generic Strategies as they attempt to develop a competitive advantage in the simulation. The purpose of this paper is to review the literature concerning educational simulations, to discuss the implementation of simulation use within the MIS course, and to highlight future growth opportunities within the course.

Introduction

In 2013, the Department of Computing at East Tennessee State University (ETSU) was presented with the unique opportunity to take over the instruction of Management 3220 – Management Information Systems. This course is a junior-level course for business students in the Department of Management and Marketing. Both the Department of Computing and the Department of Management and Marketing are a part of the College of Business and Technology at ETSU. This course can be taken any time during a student's junior or senior year as this course is not a prerequisite for another course at the University.

One of the primary reasons the Department of Computing was asked to develop the curriculum for this course was the success of implementing SAP into various courses. The use of SAP in the Information Systems concentration is utilized to provide students hands-on exposure in using, implementing, and developing for Enterprise Resource Planning (ERP) applications.

The challenge in the transformation of the course is to engage students within the Department of Management and Marketing to understand the critical importance of Management Information Systems, specifically in the areas of data and ERP. How can these concepts, coupled with business concepts such as Porter's Generic Strategies, become not only theory presented in textbooks and literature, but come to life and engage students in a deeper level of critical thinking and understanding? The goal of

this paper is to outline the transformation of the Management Information Systems course and how the use of business simulations can breathe life into the concepts discussed within the course.

Literature Review

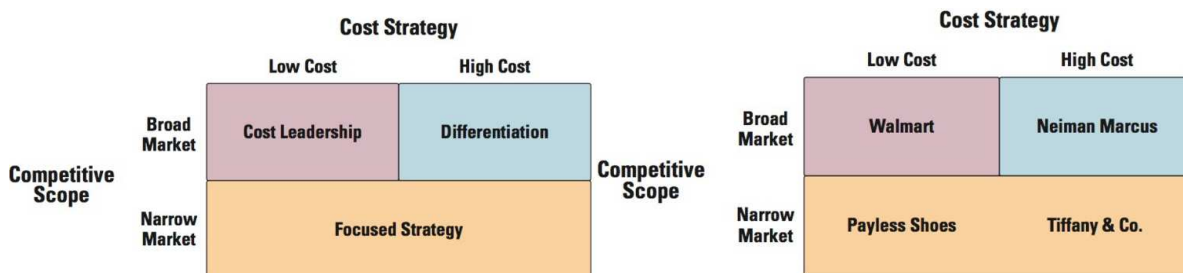
For any course considering the use of simulations as learning tool, it is important to understand which concepts from the course can be reinforced utilizing simulations. It is also important to understand how simulations are applied in education and the literature surrounding both the benefits and potential areas of concern. Finally, with different types of simulations available, researching and understanding the simulation needed to accomplish the goal of the course is critical.

The literature review will cover one of the concepts introduced to students in the MIS course, Porter’s Generic Strategies. In addition, the literature review will identify various research articles in the area of simulations in education. To conclude, a review of ERPsim as a potential simulation for MIS courses will be presented.

Porter’s Generic Strategies

Strategy is an important factor within a business. It is important to use and develop a strategy because “a company finds its industry niche and learns about its customers” (Allen & Helms, 2006, p. 434). Professor Porter, a Harvard Professor, published a framework that developed three generic competitive strategies that if pursued, a firm would be able to outperform competitors who did not follow one of the generic strategies (Ormanidhi & Stringa, 2008). The recommended strategies identified were cost leadership, differentiation, and focus. Allen and Helms (2006) note that “Porter’s Generic Strategies remain the most commonly supported and identified in key strategic management textbooks and in the literature” (p. 434).

Baltzan (2015) notes in Figure 1 below, the intersection between competitive scope and cost strategy identifies each of the three strategies Porter identified for entering a new market. In addition, Baltzan provides examples of businesses that have been successful within each of the identified strategies by Porter.



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Porter's Generic Strategies is just one of the many topics covered in the MIS course. While reading literature and research on this topic is important, practical application can help a student understand the concept and why this theory (and others discussed in a course) have practical business implications. In order to reinforce and provide practical application, students can apply their knowledge within a simulated environment.

Simulations in Education

Moratis, Hoff, and Reul (2006) identify two challenges facing management education. These challenges include relevance and development of innovative learning methods for educating students. Furthermore, business schools are criticized on the irrelevance of the management theory being taught as well as the outdated processes used to teach the students (Avramenko, 2012). One way to innovate a classroom is to use a simulation in order to allow students to see the relevance of the material in which they are learning throughout the course. This hands-on approach, as noted by Draijer and Schenk (2004), "motivates students and supports their understanding of business processes" (p. 265).

A benefit of using simulated environments in the classroom is that it encourages students to critically think through situations that may not have a simple solution. Springer and Borthick (2004) in their research discuss how students "need opportunities to learn to solve problems by constructing their own representation of the situation and creating their own understandings of what it means to develop and present acceptable solutions" (p. 278). In particular, the use of simulations could cause a developmental shift from knowing to thinking in a course by shifting from structured problems at the end of a chapter to unstructured scenarios that may generate interest in the concepts being discussed. Avramenko (2012) also argues that business simulation software should be utilized for decision making.

Avramenko (2012) also denotes other benefits of computer-based business simulations. These benefits include risk-free environments, simplified real world scenarios, learning by comparison, and time management. In addition, Tanner, Stewart, Totaro, and Hargave (2012) discuss the benefits perceived by students as engaging, useful, effective learning tools, and effective in promoting teamwork.

A study conducted by Walters, Coalter, and Rasheed (1999) set out to determine if simulation games are an effective tool in business policy courses. The conclusion, determined from the research, showed that simulations are an effective tool in a classroom and allowed students in a business policy course to implement strategic concepts with some degree of realism. Furthermore, the study noted that "business games and simulations appear to be an effective pedagogical tool at the undergraduate level" (p. 174). In order to maximize the use of simulations in the classroom, Walters, Coalter, and Rasheed (1999) provide some general guidelines for instructors who will be utilizing simulations within the course. In particular, their research notes that preparation by the student and the evaluation of their preparation is a major factor in performance in the simulation. The literature suggested to conduct random tests throughout the semester in order to determine an individual's awareness of the status of their team and their rivals.

ERPsim

One difficulty related specifically to the MIS course is the instruction of Enterprise Resource Planning. Léger (2006) identifies the lack of Information Technology (IT) experience as one of the major barriers

in teaching ERP concepts to business students. In addition, students struggle with the understanding of the importance of business integration utilizing ERP systems.

It is critical for business students to graduate from college with an understanding of ERP systems. Cronan and Douglas (2012) identified that students who graduate with ERP coursework receive an average salary of \$4,056 more than students without ERP coursework.

In order to develop this understanding of ERP concepts, the business simulation ERPsim was developed. This simulation operates on the SAP ECC platform and was awarded the 2005 academic prize for the best use of a technology in teaching (Léger, 2006). Léger notes that the pedagogical objectives in the game are (p. 442):

1. Develop a hands-on understanding of the concepts underlying enterprise systems
2. Experience the benefits of enterprise integration
3. Develop technical skill at using ERP software

Manufacturing is one of the three simulated games available in ERPsim. In manufacturing, teams of three to four students operate a cash-to-cash cycle with the business processes of procurement, production, and sales (Léger, 2006). These teams are asked to operate a make-to-stock muesli manufacturing facility. The simulation operates in real time and tasks students with creating sales forecasts, procuring raw material, producing six variations of muesli, and selling the finished product in one of three various distribution channels to potential business customers. In this process, students analyze transactional data to make business decisions with the ultimate goal of being the most profitable company (as measured by net income) within the industry.

Charland, Léger, Cronan, and Robert (2015) explain that ERPsim was developed in 2004 and has been adopted by 832 various professors, lecturers, and professional trainers over 377 universities worldwide. The main appeal to this particular simulation is that students directly interact with the ERP software in order to make business decisions for their company allowing for students to “learn about the outcome and resultant consequences of their decisions and their effects on the company overall” (p. 34). Furthermore the ERP simulation

Offers students the opportunity to reflect, test and find out what works and what does not, and gain insight into business processes, information systems, business strategy, managerial decision making, analytics and team dynamics. This game provides students with process guidelines and tools that enable realtime collaboration and collection of process data and incorporates disciplined reflection, a key requirement for deep learning (Seethamraju, 2011, p. 21).

Given the need to educate business students in ERP concepts, the Management Information Systems course began in the fall of 2013 utilizing ERPsim in order to provide students with hands-on engagement of SAP. After almost three years, the course has matured and developed to not only utilize the simulation to cover ERP concepts, but to begin to tie fundamental business concepts to the course to see the ramification of the decisions rendered for their businesses in the simulated environment.

Implementation

The Management Information Systems course is comprised of two components. The first component is a weekly lecture held on Wednesdays. It is during this lecture that we discuss the fundamental concepts of Management Information Systems. These topics include business specific concepts such as Porter's Generic Strategies as well as more technological concepts such as databases and networking. In addition to the weekly lectures, a lab is held each Friday for the three sections of the course. Up to 90 students between the three sections participate in the lab activity simultaneously. Figure 2 below outlines the weekly activities held during the lab session.

Week	Topic
Week 1	Introduction to SAP using Global Bike
Week 2	Introduction to ERPsims and ERPsims Sales
Week 3	ERPsims Production and Sales
Week 4	Data Visualization using Microsoft Excel and ERPsims Sales Data
Week 5	ERPsims Procurement through Material Requirements Planning (MRP)
Week 6	Advertising, Depreciation, Loan Repayment, Facility Improvements
Week 7	Bill of Material (BOM)
Week 8	Data Warehouse
Week 9	Company Swap
Week 10-12	ERPsims Competition
Week 13-14	Erp sim Presentations

Figure 2: Simulation Timeline for MIS Course

Each semester the course begins with an introduction to SAP by having students interact and engage with a fictitious company Global Bike. Students go through the process of entering a standard order into the SAP environment. It is through this process that a student learns about the various components of SAP and a basic overview of how to use transaction codes in order to conduct business.

Once a student has become familiar with the SAP environment, the focus of the remainder of the labs will shift to using the SAP environment to participate in the ERPsims muesli manufacturing simulation. In muesli manufacturing, teams of three to four students operate a cash-to-cash make-to-stock manufacturing facility. They are tasked with planning, production, and sales of six muesli products. At the beginning of the simulation, each team has the same six 1KG products as noted in Figure 3 below. Throughout the semester, students can change the Bill of Material (BOM) in order to produce 0.5KG or 1KG boxes of Muesli, as well as produce either premium grade product or cost-effective muesli.

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Figure 3: Muesli products

One of the first couple of concepts covered in ERPsim is sales and production. Students will use transaction code ZCK11 (Figure 4) to determine the variable and fixed costs for a particular product. They will then use VK32 (Figure 5) to change the price of products. Transactions ZVA05 (Figure 6) and ZMARKET are used to track sales within their company as well as sales within the market environment. For production, transaction CO41 is used to convert planned orders (production runs that could be produced) to production orders (production runs that materials are released and scheduled for production into a finished good).

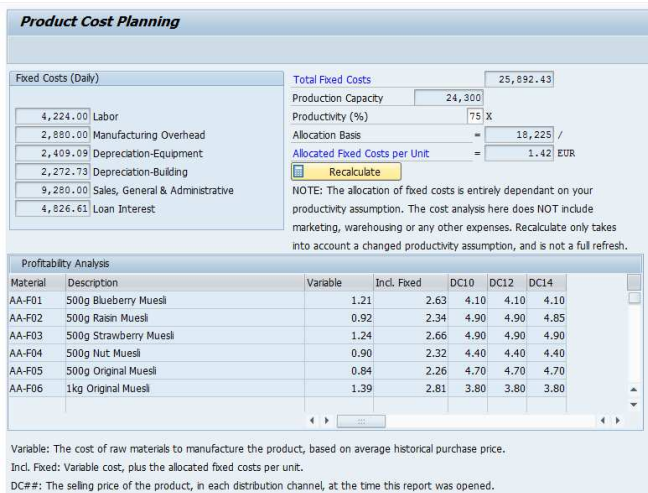


Figure 4: ZCK11

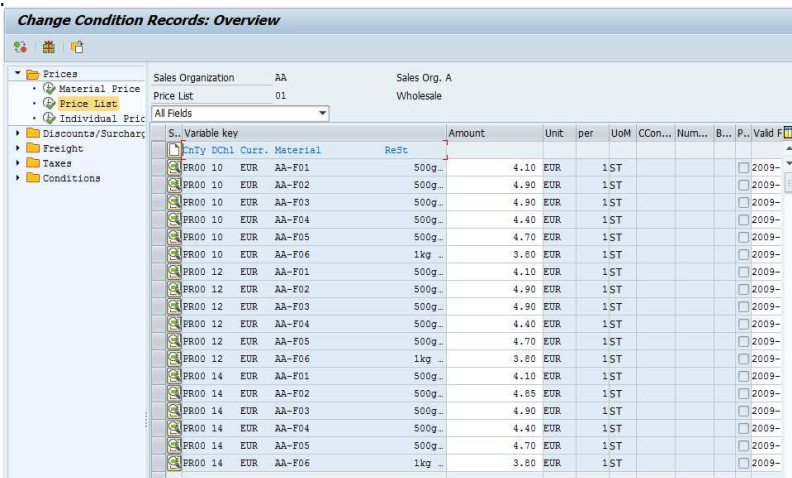


Figure 5: VK32

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Detailed Sales Order Report										
Detailed Sales Order Report: Round 6 Day 01										
Rnd	Day	DCh	Area	Material Description	Sold-to pt	Price	Qty	Value	A/R Rnd	A/R Day
5	30	14	NO	500g Blueberry Muesli	80288	4.10	7,249	29,720.90	6	10
	29			500g Original Muesli	80279	4.70	6,525	30,667.50	6	06
			SO	500g Blueberry Muesli	80217	4.10	8,585	35,198.50	6	06
	28			500g Original Muesli	80212	4.70	6,608	31,057.60	6	09
	27			500g Nut Muesli	80177	4.40	7,038	30,967.20	6	08
				500g Strawberry Muesli	80178	4.90	6,291	30,825.90	6	03
				500g Nut Muesli	80209	4.40	6,232	27,420.80	6	07
	26			500g Original Muesli	80188	4.80	5,882	28,233.60	6	07
	25			500g Blueberry Muesli	80185	4.80	6,646	31,900.80	6	10
	24		NO	500g Nut Muesli	80219	4.40	6,109	26,879.60	6	01
			WE	500g Strawberry Muesli	80267	4.90	7,073	34,657.70	6	09
	23			500g Nut Muesli	80259	4.40	7,930	34,892.00	6	04
	22			500g Nut Muesli	80249	4.40	7,468	32,859.20	6	05
				500g Nut Muesli	80265	4.40	6,810	29,964.00	5	29
	21		SO	500g Blueberry Muesli	80191	4.95	5,331	26,388.45	6	06
	20	12		500g Nut Muesli	80138	4.40	14,476	63,694.40	6	05
		14	NO	500g Nut Muesli	80227	4.40	6,851	30,144.40	6	04
			WE	500g Nut Muesli	80258	4.40	6,418	28,239.20	6	04
	19			500g Strawberry Muesli	80241	4.90	7,158	35,074.20	6	01
	17			500g Raisin Muesli	80253	4.85	3,645	17,678.25	6	02
	16		SO	500g Raisin Muesli	80207	4.90	6,366	31,193.40	5	26
	15	17		1kg Original Muesli	80138	3.80	9,908	37,650.40	5	28

Figure 6: ZVA05

Figure 6 is a representation of transactional sales data for a team in the simulation. While this transactional data has value, it can be difficult to use this data for meaningful insight into a team's sales data. During week 4, students will use Microsoft Excel's PivotChart to create dynamic visualization charts of the transactional data represented in ZVA05. Figure 7 is an example chart that displays the number of units sold over each quarter.

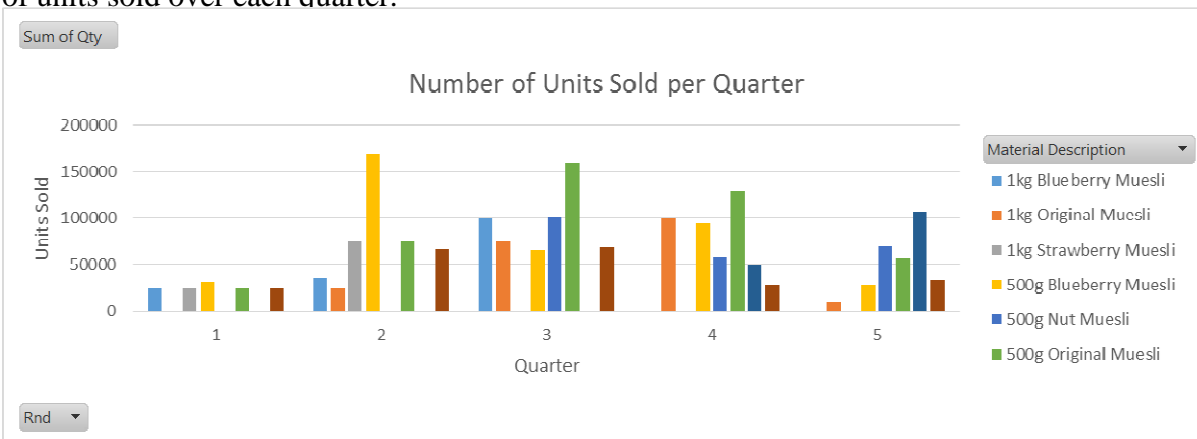


Figure 7: Example PivotChart using Transactional Sales Data in ZVA05

As the semester progresses, students have the opportunity to change the Bill of Material (BOM – the recipe for the creation of each product), increase the number of units that can be produced during a simulated day (they begin by being able to produce 24,000 units per day and can invest capital to increase production), and decrease the setup-time between product production (any time a factory switches product production, it takes 12 hours to reconfigure the factory and no products are produced during that time). It is during this time that the concept of Porter's Generic Strategy becomes important. For a business to be successful in the simulated environment, students need to understand which generic principle they wish to use for their factory and invest accordingly into facility improvements.

For example, a business that wishes to follow the broad-market, low-cost strategy must be able to produce large quantities of product with a small setup-time reduction in order to accommodate for the low margins acquired per sale. In contrast, a company utilizing narrow-market, high-cost differentiation must develop premium grade product and use advertising to encourage fictions customers to pay a premium price per product, resulting in less sales but higher margins per sale.

At the end of the term, the teams participate in a competition in order to use both their business concepts as well as ERP experience to manage their company for eight consecutive quarters. At the end of the eight quarter, the team that has the highest cumulative net income (an example is shown in Figure 8) will receive three points towards their final grade. This incentive encourages students to engage in the simulation as the value of the reward for winning is perceived as very beneficial for their success in the course.

FINANCIAL STATEMENTS - R5

TEAM	CREDIT RATING	INTEREST RATE (%)	RANK	CUMULATIVE NET INCOME	TOTAL SALES	GROSS MARGIN (%)	NET MARGIN (%)	ROE (%)	ROA (%)	D/E (%)	Mktg/S (%)
Q	AAA	5.000	1	6,916,632.04	13,024,200.60	70.696	53.106	46.369	26.207	76.931	0.016
I	AAA	5.000	2	5,268,551.05	11,572,987.35	69.722	45.525	39.707	20.764	91.232	0.000
H	AAA	5.000	3	5,178,312.48	13,158,622.34	56.847	39.353	39.294	20.411	92.516	0.000
E	AAA	5.000	4	4,352,410.36	11,287,600.40	58.381	38.559	35.235	17.402	102.477	0.368
B	AA-	5.750	5	4,127,666.94	11,673,454.05	56.733	35.359	34.035	18.015	88.932	0.000
O	AAA	5.000	6	4,037,806.40	11,259,006.75	55.779	35.863	33.543	16.798	99.686	0.413
A	AAA	5.000	7	3,076,074.67	8,775,710.28	61.953	35.052	27.772	13.407	107.140	0.018
C	AAA	5.000	8	2,612,258.60	10,122,313.46	52.168	25.807	24.615	12.087	103.654	0.014
L	AAA	5.000	9	2,553,293.29	11,457,505.66	44.684	22.285	24.194	9.676	150.048	0.871
G	AAA	5.000	10	2,297,594.23	11,309,395.90	40.199	20.316	22.312	9.512	134.567	0.467
P	AAA	5.000	11	1,761,414.75	9,548,542.00	51.732	18.447	18.045	8.266	118.312	0.013
N	AAA	5.000	12	1,369,752.98	9,094,429.35	39.126	15.061	14.619	6.426	127.499	0.000

Figure 8: Example of End of Round Financial Statements

After the conclusion of the competition, teams will prepare a seven to nine minute presentation reflecting on their experiences within the ERPsim competition. Students are required to generate charts to provide a visual description of their experiences. The charts are to have both an inward look into the company as well as a comparative look at their competition.

Conclusion

Over the past three years teaching this course, I have received positive feedback from students concerning the user of ERPsim and SAP in the course. Each semester, students are asked to complete a Student Assessment of Instruction (SAI) on each of their courses. This evaluation allows students to leave feedback concerning the course and the content of the course. Some SAI comments concerning the use of SAP and ERPsim in the course include:

- Of particular value is the training in SAP. This, I feel, is of tremendous value to business students when we enter the job market.
- Interest course. The experience with SAP is incredible!

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- I actually learned a lot in this class. It was the most applicable to the business world because of the simulation competition.
- I think the lab section of this class is very helpful and allows students to grow their knowledge of the SAP system.
- I definitely learned a lot in this class. I think that the three SAP courses offered through the Department of Computing would be hugely helpful for business students also. If I weren't graduating this semester, I would take the other two classes so I could be SAP certified. Very helpful course.
- The labs were the most helpful part of this course. I learned so much through the SAP simulation.
- The aspect of this course that was most effective in helping me learn was the lab simulation each week. I learned more from this section of the course than I have in my four years of college.
- The lab was the most effective. I learn by doing things not just by reading a slide so having the time to put my knowledge into real life was a big help.
- The lab section of this course really helped expand my critical thinking skills.
- Being able to apply what was learned through projects was really helpful in the retention of what I learned during lecture time.
- It was nice to have a lab with this lecture. It broke up just reading about the material.

One of the primary goals of the reinvention of the Management Information Systems course was to breathe life into business concepts by utilizing the business-simulation ERPsim. Through this simulation, students are able to walk away from the course with valuable exposure to the ERP system SAP. In addition, students are able to understand the value of data and enterprise applications. Finally, students can put into practice fundamental business concepts such as Porter's Generic Principles as they operate their muesli manufacturing company.

In future iterations of this course, it is the intended goal to introduce students to concepts around logistics and logistics management using SAP and ERPsim. In addition, introduce students to additional data visualization tools and business analytical tools built on SAP's latest platform, SAP HANA.

References

- Allen, R. S., & Helms, M. M. (2006). Linking strategic practices and organizational performance to porter's generic strategies. *Business Process Management Journal*, 12(4), 433.
- Avramenko, A. (2012). Enhancing students' employability through business simulation. *Education & Training*, 54(5), 355-367.
- Baltzan, P. (2015) M: Information Systems, 3rd Edition. McGraw-Hill Higher Education CSM Archive, 2015. VitalSource Bookshelf Online.
- Charland, P., Léger, P., Cronan, T. P., & Robert, J. (2015). DEVELOPING AND ASSESSING ERP COMPETENCIES: BASIC AND COMPLEX KNOWLEDGE. *The Journal of Computer Information Systems*, 56(1), 31-39.
- Cronan, T. P., & Douglas, D. E. (2012). A STUDENT ERP SIMULATION GAME: A LONGITUDINAL STUDY. *The Journal of Computer Information Systems*, 53(1), 3-13.
- Draijer, C., & Schenk, D. (2004). Best practices of business simulation with SAP R/3. *Journal of Information Systems Education*, 15(3), 261-265.
- Kotha, S., & Orne, D. (1989). Generic Manufacturing Strategies: A Conceptual Synthesis. *Strategic Management Journal*, 10(3), 211-231.
- Léger, P. (2006). Using a simulation game approach to teach enterprise resource planning concepts. *Journal of Information Systems Education*, 17(4), 441-447.
- Moratis, L., Hoff, J., & Reul, B. (2006). A dual challenge facing management education: Simulation-based learning and learning about CSR. *The Journal of Management Development*, 25(3), 213-231.
- Ormanidhi, O., & Stringa, O. (2008). Porter's model of generic competitive strategies. *Business Economics*, 43(3), 55-64.
- Seethamraju, R. (2011). Enhancing student learning of enterprise integration and business process orientation through an ERP business simulation game. *Journal of Information Systems Education*, 22(1), 19-29.
- Springer, C. W., & Borthick, A. F. (2004). Business simulation to stage critical thinking in introductory accounting: Rationale, design, and implementation. *Issues in Accounting Education*, 19(3), 277-303.
- Tanner, J. R., Stewart, G., Totaro, M. W., & Hargrave, M. (2012). Business simulation games: Effective teaching tools or window dressing? *American Journal of Business Education (Online)*, 5(2), 115.
- Walters, B. A., Coalter, T. M., & Rasheed, A. M. A. (1997). Simulation games in business policy courses: Is there value for students? *Journal of Education for Business*, 72(3), 170-174.