Using an Ocean Shipping Game to Teach Transportation Fundamentals to Supply Chain Management Students

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Abstract

This article illustrates the benefits of off the shelf simulation software to increase learning for students in the classroom. Furthermore, the use of a computer game presents a unique opportunity for increased understanding of transportation fundamentals in a fun environment. Another benefit is that the use of the simulation helps Millennial learners to gain understanding beyond a basic lecture type environment by experiencing the problems, opportunities and solutions sets applied in a realistic transportation simulation. The overall effect is students appear to retain more about specific business practices through a game experience when compared to lecture formats of the same concepts. Finally, the paper demonstrates how to better position the simulation beyond just the game mechanics to ensure the students are learning key transportation fundamentals and overall business practices.

Keywords: simulation, learning, transportation, edutainment, supply chain management.

1. INTRODUCTION

As Generation Y and Z (Millennials) move through our education system, the nature of instruction continues to evolve with them. A key question that many educators face is the best method to convey critical learning objectives to the typical Millennial student in a format that will increase learning retention, understanding, and application of various core competencies.

A good example of the challenges of teaching these types of items comes from the Supply Chain Management (SCM) major. SCM students must grasp and apply large amounts of diverse learning across various business functions (i.e., operations, logistics, transportation, purchasing, etc.) The sheer volume of material lends itself to the tradition lecture format. However, this may not provide the best learning outcomes for the student or program.

This article presents an example of using a transportation computer game or simulation to supplement the basic lecture process of teaching critical SCM tools to senior level students. The simulation used provides an excellent tool to both introduce key fundamental concepts and uses a fun, individualized, self-paced method. The SCM major learns the key concepts through experienced-based learning that can then be

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discussed in the classroom as opposed to the traditional lecture format.

After this introduction, a brief literature review highlights the importance of Millennial learning and the value of non-lecture based formats. Also, it discusses similar uses of transportation simulations as learning devices both in and out of the classroom and with various learning audiences. Next, the article discusses the application of the transportation simulation (Ports of Call) with the course to maximize its effectiveness. Finally, the article concludes with some general findings along with a discussion of future opportunities for application.

2. LITERATURE REVIEW

Millennials and Edutainment

As we approach 2020, most college students are now officially "Millennials." According to Robinson (2018), the vast majority of students in college classrooms today would be considered as Generation Y or Z a.k.a. "Millennials" due to their birth year (See Figure 1).

Based on the fact that most current college students are Millennials, the importance of understanding how this group learns will impact teaching methods. Mottet and Beebe (2006) used an information processing metaphor of how Millennial students learn. They implied that traditional lecture delivery was not as effective as with previous generations. Hosek and Titsworth (2016) build on that concept and suggest Millennials were raised in interactive learning environments and "Are accustomed to living within a rich information environment where they can be agile in searching for, electing, and using information." This implies that Millennials will learn better where they have more control of their individual environment and have numerous options to manipulate the outcomes of that situation. The implication is that a properly chosen and implemented simulation can be an effective learning tool.

Another challenge dealing with Millennials can be their views on the role of the university versus learning. Often, Millennials are characterized as viewing the college experience as a financial choice and not a learning experience (Buckner and Strawser, 2016). Millennials use their education as a ticket to future employment rather than a true learning experience. Therefore, an opportunity for a tailored simulation is to "hide" the learning into a "real-world" type of setting that appeals to the Millennials view of education. Again, an appropriate simulation could bridge the gap between the Millennials' view of the purpose of the university with the professors' goals for learning outcomes of a specific course.

Generation Name	Births Start	Births End	Youngest Age Today*	Oldest Age Today*
The Lost Generation The Generation of 1914	1890	1915	104	129
The Interbellum Generation	1901	1913	106	118
The Greatest Generation	1910	1924	95	109
The Silent Generation	1925	1945	74	94
Baby Boomer Generation	1946	1964	55	73
Generation X (Baby Bust)	1965	1979	40	54
Xennials	1975	1985	34	44
Millennials Generation Y, Gen Next	1980	1994	25	39
iGen / Gen Z	1995	2012	7	24
Gen Alpha	2013	2025	1	6

(*age if still alive today)

Figure 1 – Generation Names and Boundaries (Robinson, 2018)

Burson, Brooks & Cox (2012) help to move the discussion of Millennial learning styles and simulation towards a more business and applied role in education. In their paper, they confirmed that Millennials are active learners with a desire to engage in relevant learning experiences. Also, Millennials are products of the digital era and capable of dealing with complex simulations and expecting rapid, if not immediate, feedback. Furthermore, they found that the increasing use of business and Marketing specific simulations have created simulations of ever increasing complexity that may confuse the students when attempting to teach and/or illustrate specific learning points. Another key point that they found was that their one-day, one-topic simulations increased learning for the students and successfully demonstrated specific Marketing concepts. Finally, a critical item was that they determined Millennials are raised with concept of learning can be fun. They specifically highlight that from Sesame Street on, the students are conditioned to expect learning to be fun. This is an important point that leads to the concept of Edutainment.

The term "Edutainment" has been in use for at least two decades. The *AMA Dictionary of Business and Management* (2013) defines it as "Educations + entertainment, a term used in media industries." Walsh (2005) provides a more robust description of the use of computer games to achieve learning goals. She discusses learning modules for children in the medical field that increased learning of various applicable skills. Egloff (2004) performed a more complex experiment to identify the benefits of edutainment using young children playing a

simulated game and then replicating the learning with actual items. The key learning point was that the skills from the game transferred to the real-world sets after playing the game, and the children enjoyed the overall process. Egloff's findings are important to this article for two reasons. First, the confirmation of enjoyment and learning (Edutainment) can work. Second, the young subjects in the original study fit the definition of a Millennial from Robinson's timeline (2018) which reinforces the previous concept of Millennials were brought up playing games that help to form the concept of learning should be fun.

In summary, Millennials have strengths and weakness just as each preceding generation. Tulgan (2004) does an excellent job of summarizing the positive attributes of this group of being technologically worldly or digital natives, fast-paced, highly educated and results driven. However, there are inherent challenges to the Millennial cohort as well: lack of focus and direction, inadequate personal and relationship skills, and defensiveness regarding constructive criticism (Tyler, 2008). These characteristics highlight the need to shift from a traditional lecture format to a different pedagogical style to improve learning with this generation. The implication is that some form of entertainment based learning would likely be more successful.

SCM & Transportation Simulation

Given the possible benefits of simulation based learning systems, an important next step in examining the literature is to identify how SCM simulations have been used in the classroom. A secondary question would be if they have been used as instructional tools, were Millennials the primary subjects. Unfortunately, the literature is less robust in this area than in the broader studies of Millennials as a whole.

The first challenge is the very large overall body of literature about transportation simulation learning. However, only a small fraction is related to pedagogical areas. The vast majority of the research can be categorized into two distinct subgroups: Simulations use of improving systems or machine learning through simulation. For example, Chen and Levinson (2006) explore the concept of using simulation to learn how transportation networks will evolve over time. On the other extreme, Wojtusiak, Warden and Herzog (2012) illustrate the concept of machine learning using transportation simulation. These extremes represent the majority of articles. In one sense, this large block of research is valuable to highlight the potential benefits of simulation. On the other hand, it also demonstrates the value of learning through simulation even if the recipient is machine based.

However, there are a small number of studies that help to frame the use of SCM software in the educational experience for students. The first is a dated, but very relevant, work looking at using a transportation simulation on a "micro" computer. In today's terms, Rutner, Gibson and Kent (1997) used a transportation simulation to educate SCM/Logistics majors on various areas of the transportation industry. They used a variety of tools to try and teach everything from ERP to core transportation skills in the classroom using personal computers. One side note is that they even identified the concept of edutainment as a benefit to their study. Their overall findings were positive.

A more recent study used a SAP/ERP Software Simulation in a SCM/Logistics classroom to help students understand the basic concepts of inventory control, forecasting, distribution and transportation planning (Angolia dn Pagliari, 2018). The authors used the SAP University Training software to perform simulations that mirrored many real-world SAP tasks as part of the learning process that highlighted many of the areas identified. The goal was to better prepare students with both the specific SAP/ERP skills and a better understanding of the various learning concepts across the supply chain. Finally, the authors had a word of caution. Just as previous studies had identified the challenges of simulation complexity, the SAP/ERP simulation had been refined through five iterations to produce a "Supplement" to the learning.

A good summary of the possible uses of specific games in SCM/Logistics/Transportation was done by Cvetic and Vasiljevic (2012). In their article, they reviewed the 47 identified games/simulations that were being used in various universities as educational tools. There are two relevant findings from the reader. First, the article does provide a database of 47 potential games that can be used by faculty. Next, it ranks them on a composite scoring system. However, the highest ranked games are more often non-computer-based simulations (e.g., The Beer Game in paper format in their study). The net result of the article was to highlight the value of the various simulations and remind readers that not all simulation based learning needs to be computerized.

To summarize the concept of using simulations in the classroom, Sweeney, Campbell and Mundy

(2010) did a study on using off the shelf, commercial software in a graduate SCM class. Their findings provide an effective overview of the literature. They stated that "Incorporating commercial software in university programs presents a myriad of challenges and therefore is rarely done. However, providing students with in-depth knowledge of commercial logistics and supply chain management software improves their understanding of supply chain issues and provides a key differentiator in the marketplace." In short, simulation is an effective method to train students with concepts and provide real-world experience, but it is often time consuming and difficult to do in the classroom setting.

Based upon the two areas of examination in the literature review, there appears to be an opportunity to benefits students. Clearly, Millennials as digital natives can not only benefit from simulation, but also can gain competitive advantage on peers at other institutions. However, the key caveat that many of the literature sources highlighted was the complexity and difficulty of integrating solutions into the classroom.

3. IMPLEMENTATION

Solution Process and Selection

Given the benefits listed in the literature review, Millennials students would likely be an excellent target audience for using some form of simulation in the classroom. Furthermore, their strengths as digital natives would support the option of a computer-based model over traditional paper or board solutions. Finally, the concept of edutainment would further support the idea of a fun game/simulation to be used as the teaching tool to support course learning objectives.

In addition to the benefits that would support a computer game/simulation, the goal would be to minimize the disadvantages that were identified as well. The solution should be easily understandable and not be overly complex to the user. A second item must be the chosen software should be able to fit into the course without creating significant extra work to modify the curriculum or significantly increase the professor's workload. Finally, and most importantly, the computer game MUST incorporate the teaching points, skills and concepts that are critical to the course of major. In AACSB speak, it must support either the course's or the major's student learning outcomes in a clear and understandable fashion.

As identified previously, Cvetic and Vasiljevic (2012) identified 47 potential simulations to use. However, a large percentage were typical pen and paper simulations that were useful, but not meeting the intent of computer-based learning that could also be fun. A good example was the inclusion of the "Beer Game" as a choice. While this is an excellent tool to teach forecasting, supply chain communication, etc., the board version was not meeting the course's learning outcomes of improving understanding of transportation terminology, concepts and practices in either the paper or computerized version. Therefore, a different option needed to be identified to meet the specific goals of learning and edutainment.

After evaluating over ten various computer business "games," one stood out as being the best fit for the specific needs of the course. The program was titled "Ports of Call" or PoC for the remainder of this paper. PoC is a computer game that has existed since the late 1980's for a number of computer formats. Early in its commercial sales, it was ported to DOS and then later to Windows and works today on Windows 10 based systems. Its one major disadvantage for use in the classroom is there is not an Apple/Mac version available. (Note: our university was able to license an additional 10 copies and run PoC through Parallax. While this was not an optimal solution, it allowed Mac users the same access to the program.)

Some of the strengths to using PoC were that it was a well-established program. Therefore, there were not bugs or software crashes. Also, it had evolved over time to have numerous options and settings. PoC was well suited to creating a tailored learning experience to meet the needs of the course. For example, the basic model of the game is an ocean shipping/transport operation where each player runs his own company. In addition to the business side of the game, the various options allow plays to pilot large ships through various ports. However, the benefit of the maturity of the game was that it allowed all of the non-business functions to be minimized. Therefore, the students could "play" the ship sailing once or twice, but then focus their efforts on running a transportation company. Finally, the cost was minimal at approximately $12 per student to download and operate on their laptop (Note: Mac users were similar, but slightly different pricing and execution model.)

Ports of Call Results

PoC turned out to be an excellent choice of software. The program not only allowed the

players to run a transportation company, but also forced them to work in a simulated world-wide system with freight markets, outside or external events and with or without competitor companies. The program forced players to make significant business decisions concerning which ship(s) to buy due to cost, students' ability to borrow, market availability of various types of equipment and managing the students' specific company status/reputation. In addition to the specific ship(s) the play purchased, the options included many classes of bulk freighters, oil tankers, roll-on/roll-off ships, container ships, passenger ships and a few special freight ships (i.e., LNG, etc.) Figure 2 presents a screen shot of one the many classes of ship available to purchase at the beginning of the game (Appendix). Also, it should be noted that the game allowed a free play mode that started in 1980 and had no end date limitation and newer classes of ships were added at various times in the game.

The next benefit to the game was that students were forced to buy a small bulk freighter as their starting option due to costs. While they learned the basics of running the company, they performed small loads of various commodity types of freight throughout the world. Figure 3 (Appendix) presents an example of how the students viewed the world's freight market based on the type of ship they were booking freight against and incorporated the ship's location at the time of decision. In the early stages of the simulation, the students learned about the weight limitations of freight shipment. Also, they experienced challenges with booking subsequent freight at the initial destinations which lead to deadheading and future planning considerations. Finally, they quickly learned the cost to speed tradeoffs of revenues and fuel burn based on faster shipments. Each of these lessons would be reinforced by classroom learning as the semester progressed.

It should be noted that the students were required to play the game outside of class as individual players. In other words, each person operated his or her own shipping firm. And, the results were competitive and considered as part of their final overall grade. Therefore, most students were motivated to do at least marginally well to ensure they passed the project that usually accounted for approximately 20% of their final grade. One other key point was to ensure that everyone was operating on the same level of difficulty, the base or easiest settings for the simulation were used starting in 1980 with no end date. Therefore, a more motivated student could theoretically play hundreds of years of simulation time in an effort to earn the best overall score. With mostly motivated students, they soon grew their companies. As they progressed, differing strategies were developed by the various players. Some opted for large fleets of small bulk carriers. Other moved to a few larger ships. Some students choose to move into ferries, ro/ro, tanker, container, etc. operations. The result was a diverse set of strategies and outcomes for the students. Many faced difficult scheduling problems as they learned not all containers or automobiles would have the same origin and destination pairs. Students would miss shipments and pay large financial penalties and see their company's status plummet. This would lead to a reduction of opportunities on the freight market as shippers would begin to avoid their company. Other issues would arise such as ships lost at sea. Students would overlook or deliberately reduce the maintenance budgets on their fleets and suddenly lose ships in bad weather when they became floating rust buckets. While these points illustrate a number of the major learning points, there were a myriad of additional items from Marketing to Finance and of course transportation that had to be considered as players made decisions.

At the end of the semester, each company had to prepare an overall report of how their company performed. The game helped by doing a fair job of keeping track of financial and other operational data. Figure 4 (Appendix) presents the selection screen for the reporting functions of the game. The game provided a reasonable amount of information, but for use in the classroom more detail was needed. So, each student had to use the information from the game as a starting point and create a summary document that mirrored an annual 10K report with much greater financial detail. A secondary requirement was to produce Excel charts, graphs and spreadsheets with all the annual data (i.e., 1980-20XX whatever year they ended). This helped to improve spreadsheet skills and increased their understanding of financial reporting requirements for public corporations. In addition to the basic final report, a number of leading questions had to addressed that included company strategy, changes in operations, lessons learned and other items. This helped the students to review how they operated their company and the good/bad decisions made. Near the end of the semester, a class period was used to cover all the key learning points from PoC.

The overall result was that students ran fairly realistic shipping companies. They were forced to compete in a simulated world market for freight.

They faced basic transportation decisions on freight selection, routing, maintenance and a host of related items. All of these could then be incorporated into the classroom discussion of key learning points.

4. FINDINGS & CONCLUSIONS

The PoC project was used in a number of senior level transportation courses as part of a SCM major. The net results were very positive. As discussed previously, the students gained a much deeper understanding of specific transportation concepts. These included, but were not limited to the following:

- Types of Ocean Vessels and Carriers (bulk, ro/ro, etc.);
- Challenges of weight vs space (i.e., Weighing out vs. Cubing Out of transportation equipment);
- Speed vs. Cost trade-offs both in terms of revenue impact and operational costs;
- Impact of equipment maintenance on operations and revenue;
- Fuel costs;
- Transportation and SCM industry terminology (i.e., bunker, lay days, charter, etc.);
- Roles of terminals in a carrier's network;
- Deadhead and transportation route planning;
- Freight consolidation; and,
- Various miscellaneous other items.

As a learning tool, the simulation was very effective in helping students understand many of the practical challenges that carriers face on a day-to-day basis regardless of mode.

For the faculty member, the program was viewed as a success. Not only did it support learning in the transportation areas listed above, but it also helped with other general business concepts, Excel skills, writing abilities and presentation proficiency as well. The overall impact on the faculty was fairly low after the first semester's learning curve was completed.

The students were equally pleased in general with the process. Approximately 80% of the comments about the simulation were positive. Many of the students highlighted their learning increased and often used one of the listed skills as an example of how they better understood the transportation process after using PoC. Many also listed it as a fun experience because they enjoyed playing PoC. However, there were a number of negative student comments as well. They could be group into two categories. The first included students that just did not like PoC or the game. In their defense, after most of the learning points were achieved, it became repetitious to move freight. They grew tired of PoC, but felt they had to continue playing to ensure they were profitable enough to earn a good grade. This may have been exacerbated by the competitive grading system instituted by the professor. This led to the second major complaint. Students that did not do well all disliked that they were graded based on actual performance compared to their classmates. Here the Millennial view of we are all winners created an issue with the grading and was not truly a PoC issue as much as a grading format choice. Both of these could be addressed with a change in the grading format while still achieving the same learning outcomes in future iterations.

There were a few technical issues that created difficulties for the students and faculty member. Another issue with the software was identified previously with the lack of a Mac version. With the high percentage of college students owning Macs (approximately 30-40% in the two sections), it required the use of the College's servers as part of an IT workaround. It was effective, but did create a number of save game issues for those students. Also, initially those students had to log into the College's network from the building but that was addressed during the semester. The last technical issue was the age of the program itself. It appears that the company was no longer actively supporting it and a number of help requests went unanswered during the semester.

In addition to the technical issues, there were a few areas that PoC itself hindered learning. First, the freight market was an excellent tool. But, the revenue models were widely inaccurate compared to real-world modern day pricing. A quick check with the Baltic Freight Futures Index highlighted numerous, major discrepancies. For example, container rates were ridiculously low and bulk rates were significantly too high. While these inaccuracies did not dramatically reduce learning, they did teach some bad habits of prioritizing bulk over container operations in the belief it was more profitable for companies. These types of issues were addressed at the end of the semester with discussions on real-world pricing and how companies would adjust operations. Another challenge was that students would get lost in playing the game and forget to maintain financial records for each year even though the professor constantly stressed the game did not keep year over year data, they would forget to record the annual results needed for analysis at the end of

the semester. This also illustrates that PoC is a game and not a true business simulation. Its collection of financial and operational data needed to be more comprehensive for business majors. Finally, students complained about the "fairness" of the process. The Mac users complained that they had a more difficult version to use going through the school's servers. The PC students complained they had to pay ($12) for the program and the Mac users did not (school license). This issue was mostly mitigated by the discussion that both models had limitations and trade-offs and every student was free to switch operating systems if they felt the other significantly benefited. This usually muted any fairness complaints.

The final results were that PoC may not have been perfect, but it worked very well to teach key points while minimizing complexity to the students and without much additional work on the faculty member. Overall, it was a very positive experience for the vast majority of the students. Even for the small percentage of students that did not like PoC, most admitted they did learn a great deal from using it as a learning tool.

5. FUTURE OPPORTUNTIES

The use of PoC was a success, but the limitations of the program highlight that maybe another game would work as well or better. Given the age of PoC and limited support, it was difficult to buy the licenses in 2019. Therefore, the professor began to reexamine the selection process. After a thorough search, a few alternatives were identified. These included broader transportation games (multiple modes) and other specific modal simulations (rail, water, airline-passenger.) Also, they were screened to ensure there was at least a PC & Mac option available. Furthermore, a few were found that were Iphone/Ipad/Android capable as well. At the time of this writing, a detailed comparison of two is being conducted to see if there is a better fit going forward. It appears that "TransOcean 2 – Rivals" may be the successor to PoC. It operates very much along the same lines and addresses many of the limitations identified (financials, Mac, etc.) However, it is significantly more expensive ($30) and needs much more powerful hardware to run. So, a future article may address the change from PoC to TransOcean or a similar product.

Also, this paper was intended to provide an example to follow academics. It was not intended to be a rigorous study on the impact of simulation use in the classroom. Many of the articles had already confirmed this. However, the use of the software does present an opportunity to study the specific impacts on student retention. The reviewer comments highlighted the benefits and it presents an excellent future research opportunity.

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Appendices and Annexures

Figure 2 – Example Container Ship for Purchase
(other container classes listed in "select ship menu")

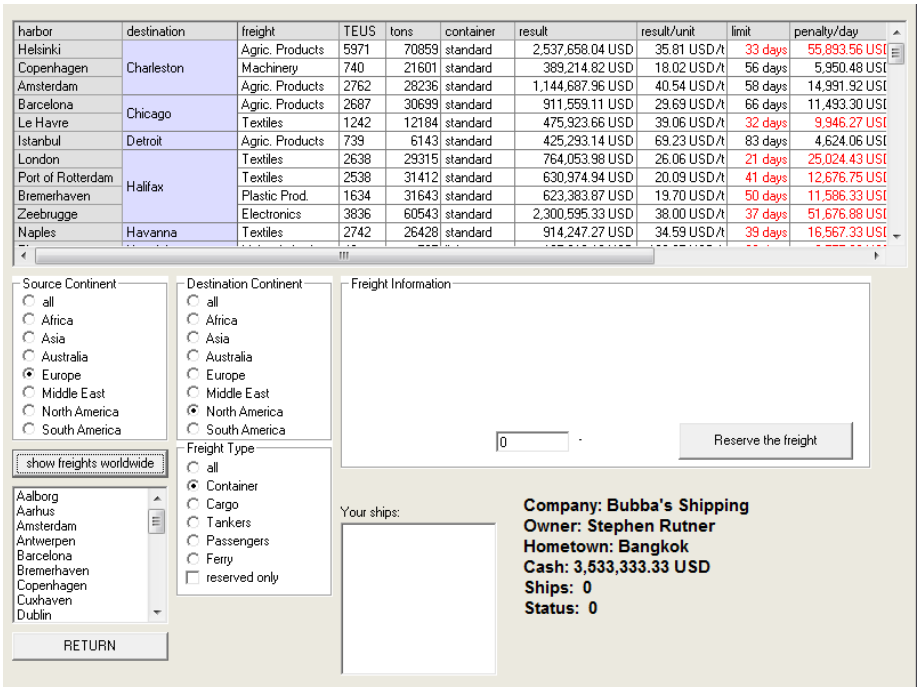

Figure 3 – World Freight Market for Cargo Booking

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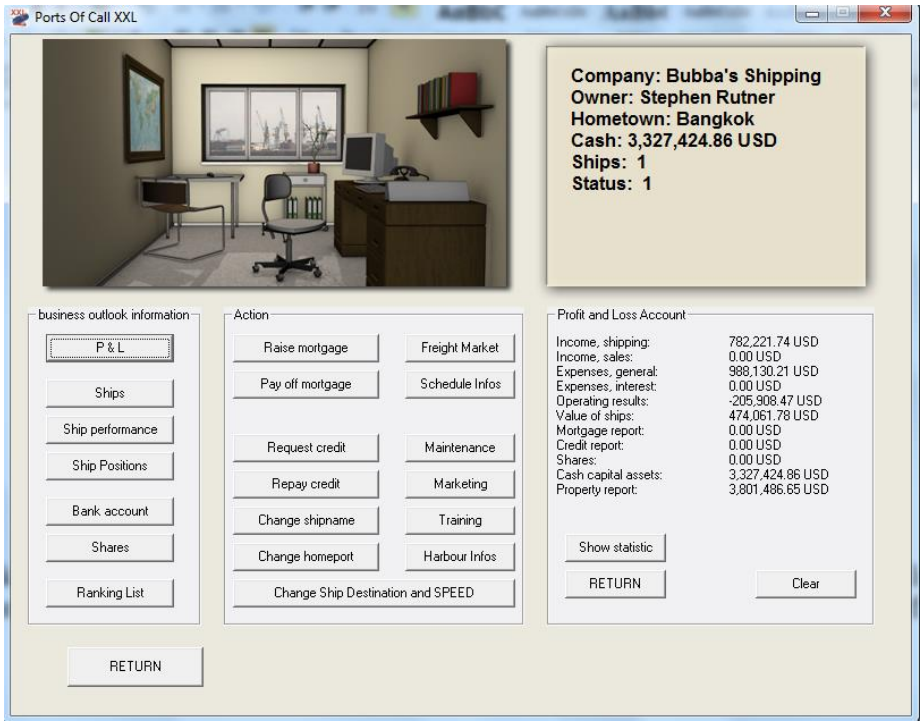

Figure 4 – PoC Reporting System Overview Page